MECHANICAL ENGINEERING

• MAY 1952 •

Operating Experiences With Cyclone-Fired Steam Generators . . . . . *V. L. Stone and I. L. Wade* 359

Properties of Some Heat-Resistant Adhesives . . . . . *C. W. Roush and A. J. Kearfott* 369

Operating Experiences of the Talgo Train . . . . *A. W. Clarke* 375

The Transit Van System of Transportation . . . . *J. R. Alison* 377

Operating Experiences With Stationary Gas Turbines . . . . . *P. R. Sidler* 381

How to Increase Productivity in Small Plants . *F. K. Shallenberger* 384

Conservation of Manpower and Materials . . . *H. H. Anderson* 389

Departments

Briefing the Record, 392
ASME Technical Digest, 405
ASME News, 416
Keep Informed, Adv. Page, 41

ASME SEMI-ANNUAL MEETING — CINCINNATI, OHIO, JUNE 15-19, 1952

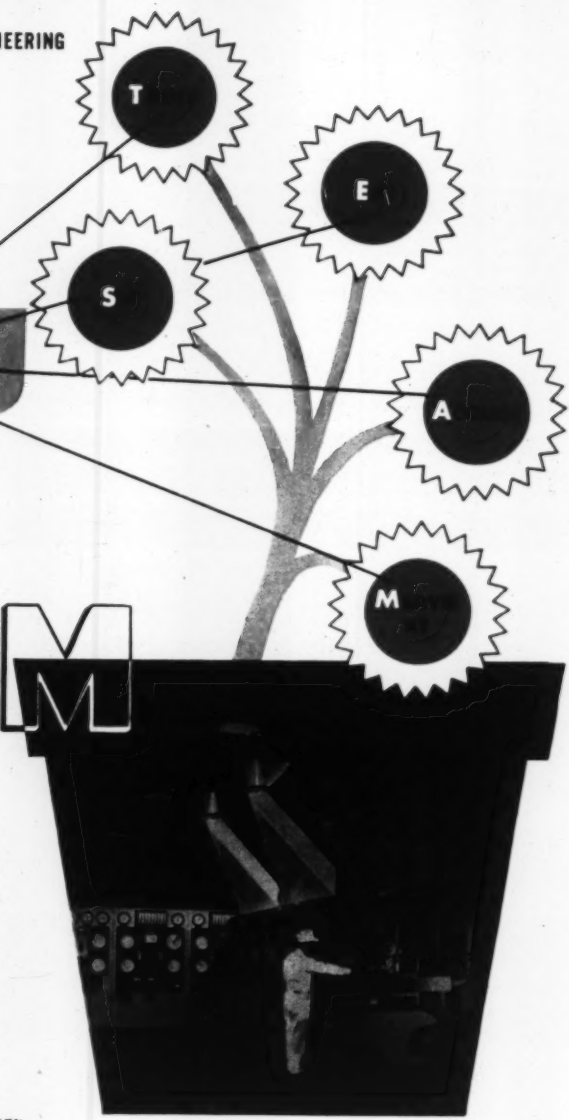
THE ECONOMICS OF STEAM ENGINEERING

NEARLY EVERYTHING

YOU

STEMS FROM

STEAM



Modern low-cost steam is a driving force behind your daily comfort and convenience, helping in hundreds of ways to give you the best values . . . the highest standards of living . . . you'll find anywhere in the world.

Since the days of "Fulton's Folly," and before, steam has provided a versatile and economical basic force which, translated into human terms, has warmed our homes, processed most of the things we eat and wear and use, transported us from place to place on land and sea, and made slaves of thunderbolts chained to the nearest wall-socket.

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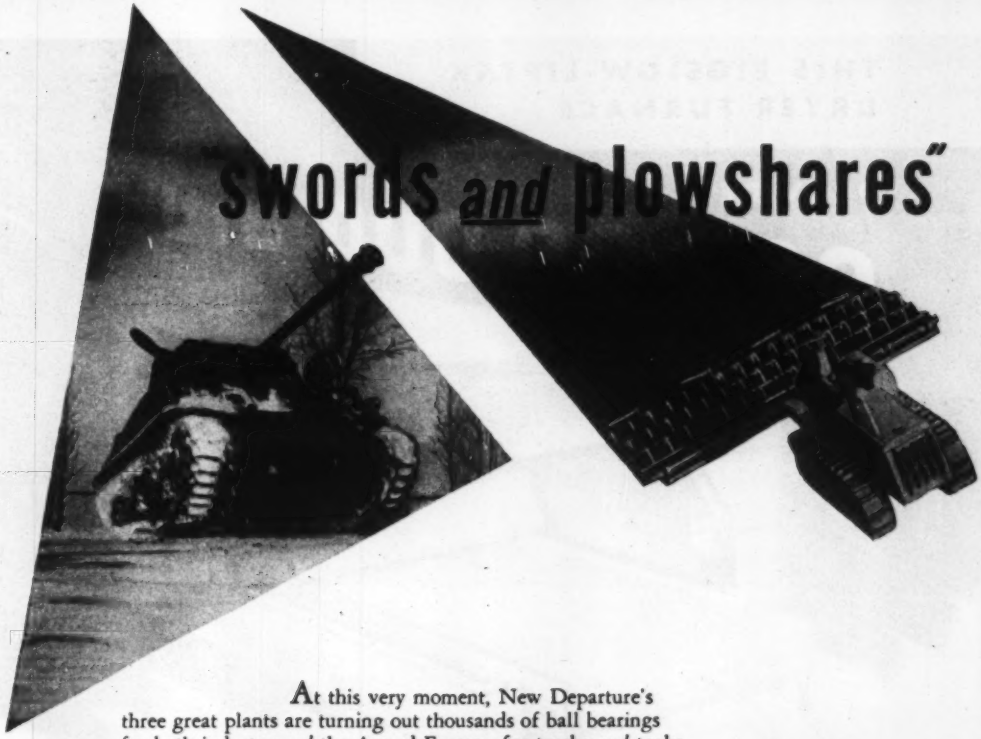
Progressive, resourceful engineering is a 75-year tradition at B&W, where men of vision who thrive on challenge blend skill and imagination to advance steam engineering and the many other industrial activities they serve.

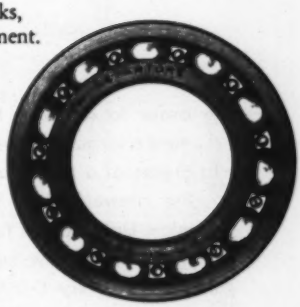
BABCOCK & WILCOX

G-553

"swords *and* plowshares"

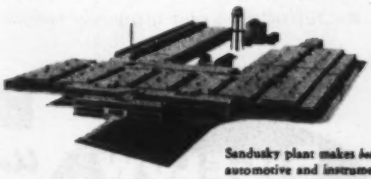


At this very moment, New Departure's three great plants are turning out thousands of ball bearings for both industry *and* the Armed Forces—for trucks *and* tanks, jig borers *and* jets, household appliances *and* electronic equipment.



Because all New Departure ball bearings are of the same materials, receive the same heat treatment, are manufactured by the same precision methods, conversion from one to the other at New Departure is largely a matter of changing the emphasis on types and sizes.

Whatever *your* bearing requirements, feel free to call on New Departure. Its engineers, vast research facilities, and the tremendous capacity of its "guns-and-butter" plants are your assurance of the best possible production schedules.



Sandusky plant makes *both* automotive and instrument bearings.

Nothing Rolls Like a Ball...

NEW DEPARTURE

BALL BEARINGS

165

NEW DEPARTURE • DIVISION OF GENERAL MOTORS CORPORATION • BRISTOL, CONNECTICUT

MECHANICAL ENGINEERING, May, 1952, Vol. 74, No. 5. Published monthly by The American Society of Mechanical Engineers, at 20th and Northampton Sts., Easton, Pa. Editorial and Advertising departments, 29 West 39th St., New York 18, N. Y. Price to members and affiliates one year $3.50, single copy 50¢; to nonmembers one year $7.00, single copy 75¢. Postage to Canada, 75¢ additional, to foreign countries $1.50 additional. Entered as second-class matter December 21, 1920, at the Post Office at Easton, Pa., under the Act of March 3, 1879. Member of the Audit Bureau of Circulations.

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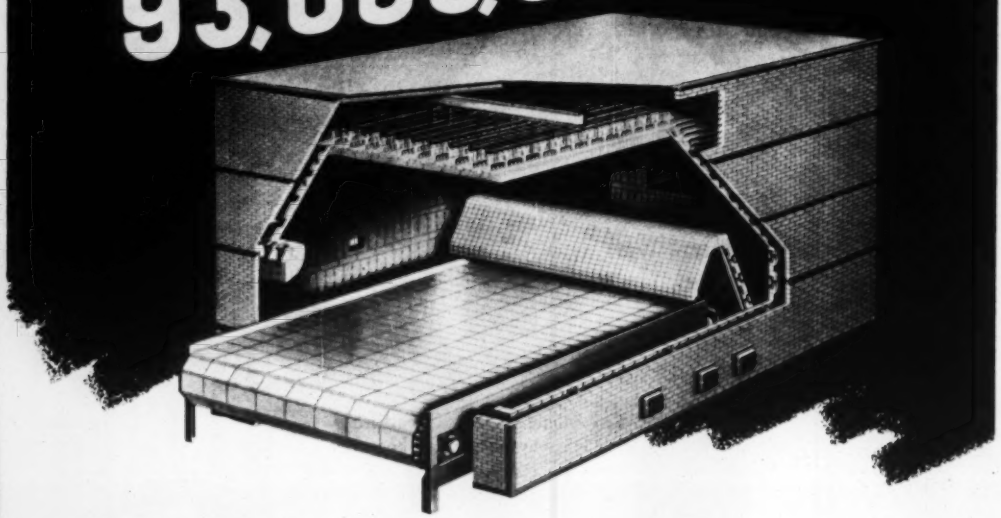

In order to dry coal, this B-L customer wanted a large volume of heat delivered to dryers at a temperature of 1200° F.

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They'll enjoy low maintenance costs. Inherent in every B-L furnace design is long refractory life. Cool, tempering air is brought through special inlet tile in the walls of a Bigelow dryer furnace, saving the refractories and gradually reducing the heat to the required outlet temperature. Unit suspension of tile makes installation easy, too.

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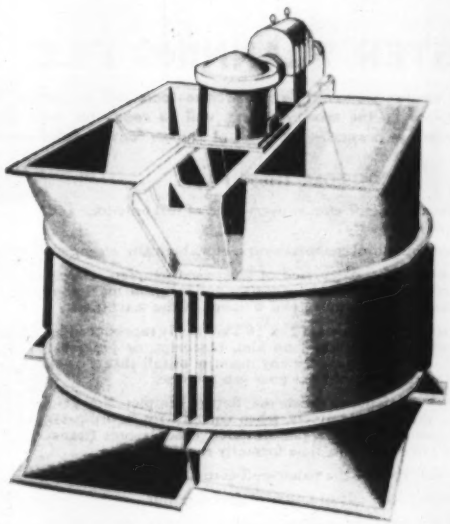
The Ljungstrom operates on the continuous regenerative counterflow principle. The heat transfer surfaces in the rotor act as heat accumulators. As the rotor revolves the heat is transferred from the waste gases to the incoming cold air.



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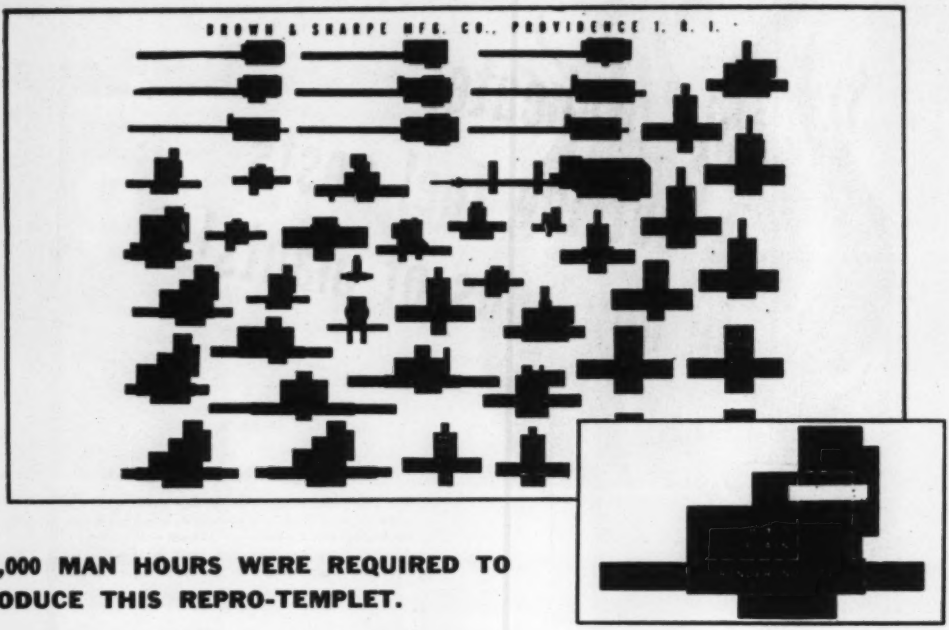
5,000 1/4" SCALE MACHINE TOOL AND EQUIP. TEMPLETS ON FILM!



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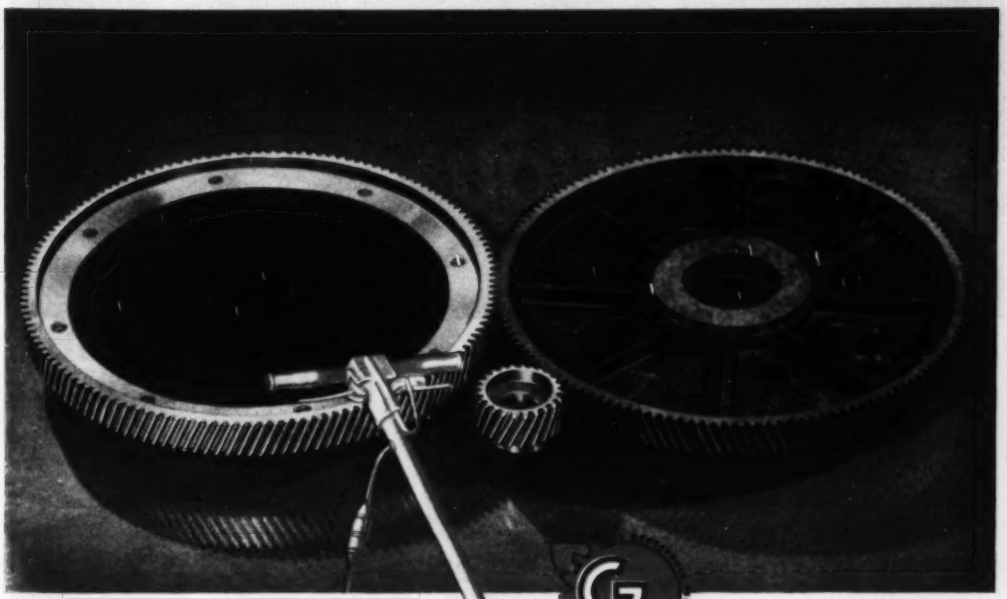

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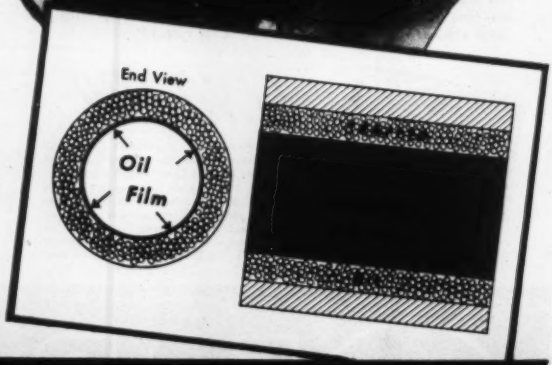

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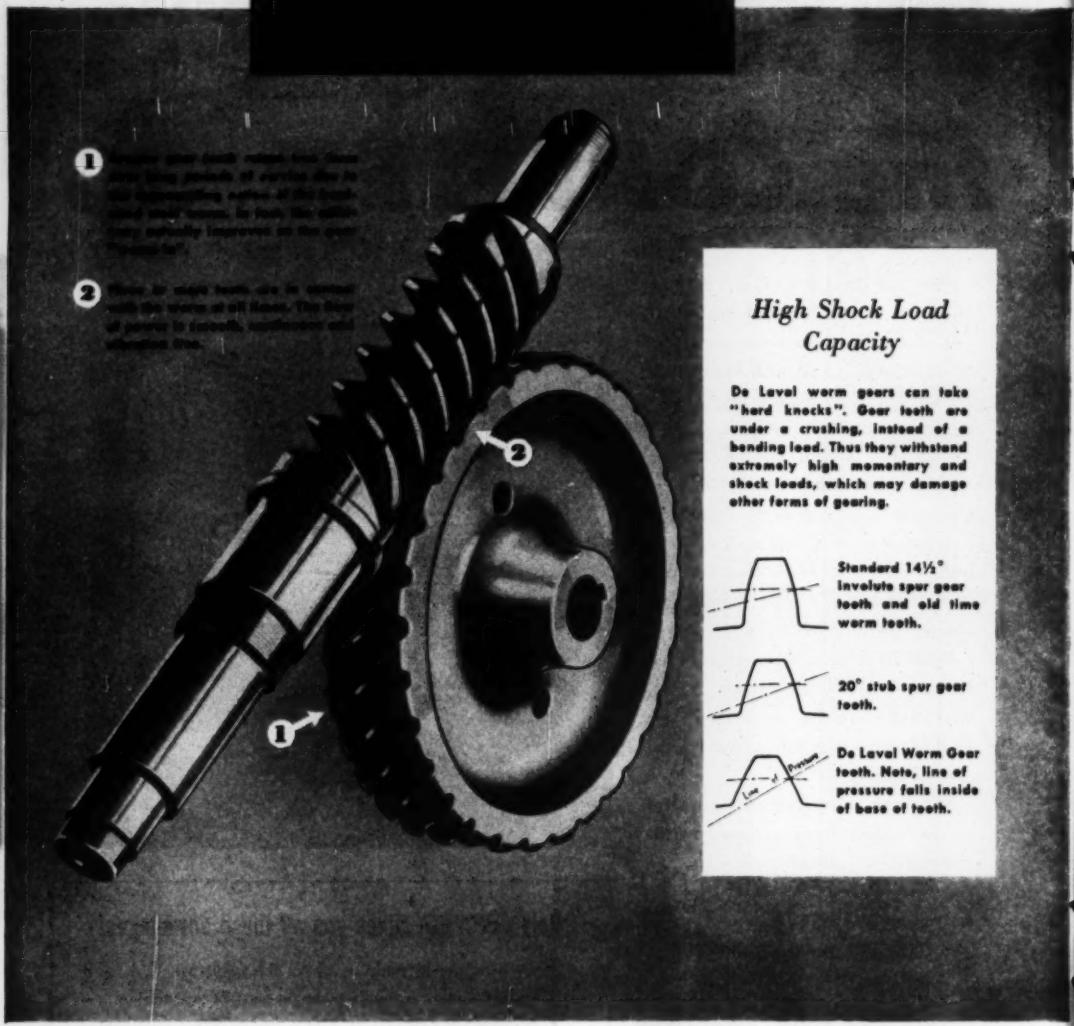

High Shock Load Capacity

De Laval worm gears can take "hard knocks". Gear teeth are under a crushing, instead of a bending load. Thus they withstand extremely high momentary and shock loads, which may damage other forms of gearing.

Standard 14½° involute spur gear tooth and old time worm tooth.

20° stub spur gear tooth.

De Laval Worm Gear tooth. Note, line of pressure falls inside of base of tooth.

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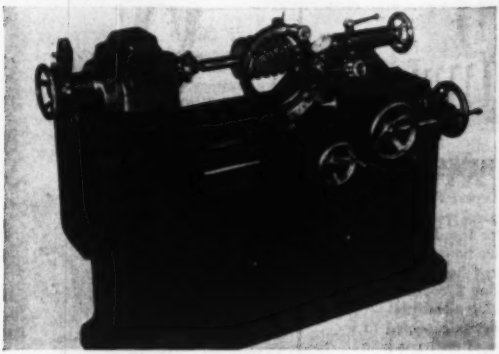
made for the machine of the future

HEAT TREATMENT INCREASES WORM LIFE! Carefully selected alloy steel for worms is surface-hardened and heat-treated in controlled atmosphere, forced convection electric furnaces under modern metallurgical inspection and control. This heat treatment provides hard thread surfaces and most desirable core properties.

PRECISION GRINDING ASSURES ACCURATE THREADS! The most modern thread grinding machines available leave nothing to chance at De Laval. To obtain perfect contact between worm and gear, threads of worm are ground to correct lead and contour, using the master worm as a reference. Thousands of installations have proved these quality standards.



HOBS AND WORMS ARE PRECISION-CHECKED! The profile of the worm thread is compared directly with the master worm on this specially designed machine. This insures smooth, quiet, efficient operation. Use of De Laval master worms results in uniformity, correct thread thickness, precise tooth contour and interchangeability of parts.

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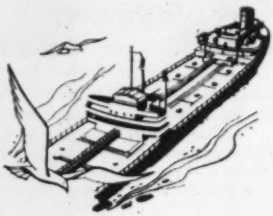

BON VOYAGE

The very fact that the cargo is *potentially* dangerous requires every precaution for safety on an oil tanker. American Blower fans and blowers more than meet the rigid specifications for ventilating equipment on these vessels. American Blower ventilating equipment includes explosion-proof motors, spark-proof fan wheels and housings and carries Certified Ratings. If this touches on a problem you're facing, our nearest branch office will be glad to help you.

HOSPITAL COMFORT

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POWER PLANT NEWS

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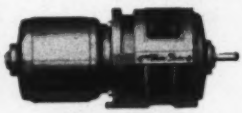
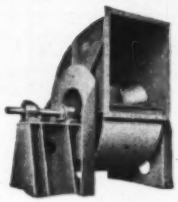
Dust Collectors



Gyrol Fluid Drives



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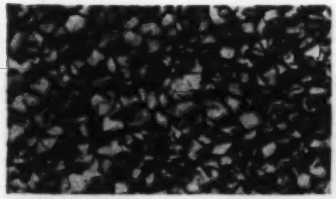
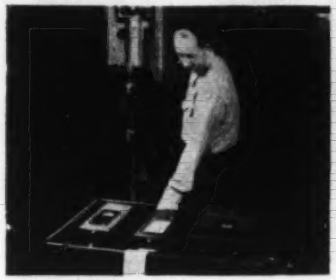
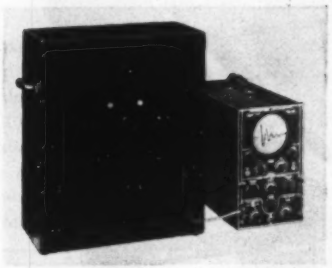


SHOWS SURFACE DETAILS. This Faxfilm® projection of a cylinder bore treated with Lubrite shows crystal size and coverage. Test requires only one minute to make. Special transparent plastic film is pressed against test surface, removed and mounted, then placed in special Faxfilm Projector for magnification of 30 or 100 times. Shows roughness, wear, grain, texture, and finish in minute detail.



CHECKS WELDING TIMING. This Brush Analyzer consisting of a-c amplifier, d-c amplifier and direct-writing oscillograph is used by Taylor-Winfield Corporation to check the current and timing calibration of each spot welder before shipment. By observing wave shapes the inspectors calibrate controls quickly and accurately.



"PLAYS BACK" TRANSIENTS. The Brush Transient Recorder is designed to record and graphically show transient phenomena of ⅕ second or less. This instrument records transients on tape, then reproduces them for visual analysis by an oscilloscope. Signals can be shown complete, or expanded on the screen to show detail. Electrical transients, such as brief spot welder current surges, or other transients which can be converted into electrical impulses can be studied.

For catalog describing these Brush instruments, write The Brush Development Company, Dept. P-30, 3405 Perkins Avenue, Cleveland 14, Ohio.

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IRONING COMFORT INTO SHOES is done with Compo's "Lining Smoother" — a heated metal form which is placed inside a shoe and spread open, to smooth wrinkles out of the lining. For the precise temperature control needed to avoid scorching with too high heat, or inadequate ironing with too low heat, a Fenwal THERMOSWITCH unit provided the ideal solution.

A FENWAL THERMOSWITCH CONTROL may solve your problem, too. Its external, single-metal shell expands or contracts *instantly* with temperature changes, making or breaking enclosed electrical contacts. Compact, highly resistant to shock and vibration, Fenwal THERMOSWITCH units have solved hundreds of problems where heat is a factor.

SEND FOR THIS NEW CATALOG for complete explanation of the unique THERMOSWITCH unit. Also ask for more detailed, illustrated discussions of the problems above. Fenwal engineers will be glad to help you solve your temperature control problems involving heat, humidity, radiant heat, pressure and other variables. Write Fenwal, Incorporated, Temperature Control Engineers, 55 Pleasant Street, Ashland, Mass.

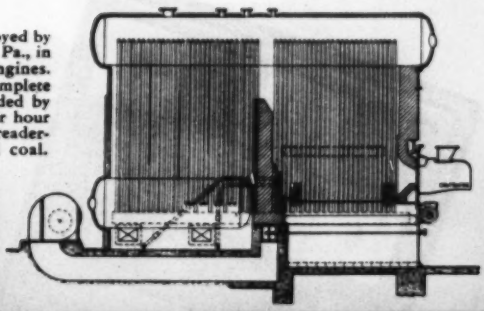
Fenwal

THERMOSWITCH®

Electric Temperature Control and Detection Devices

SENSITIVE... *but only to heat*

This 2000-ton press is the larger of two employed by the Ellwood City Forge Company, Ellwood City, Pa., in shaping huge crankshafts for the largest diesel engines. Steam for these giant presses, as well as a complete forge-hammer shop, and plant services, is provided by a Keeler Type CP Boiler, 30,000 lbs. steam per hour maximum, fired by a Centrafire (Westinghouse Spreader-Type Stoker) with Link-Grate, burning local coal.



LOAD SWING
from zero to 30,000 lbs. *instantly!*

As the giant presses and forge hammers at Ellwood City Forge Company are turned on and off, load upon the boiler . . . and the stoker . . . swings *instantly* from 10,000 to 30,000 lbs. . . . and back again, just as suddenly. In summer the swing is from zero to 30,000 lbs!

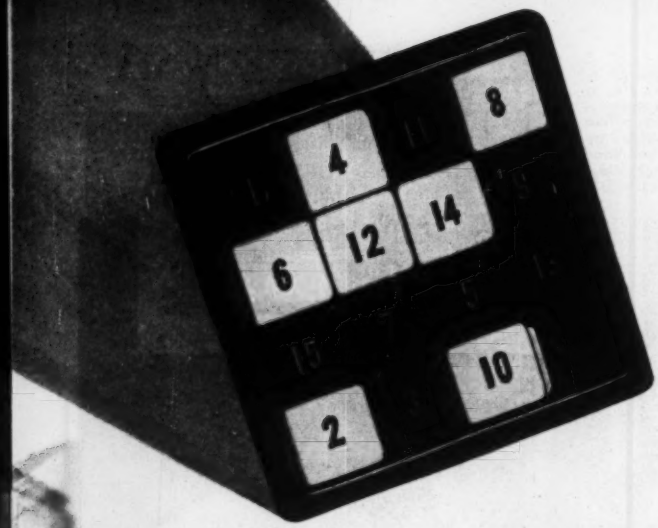
That's a grueling test of flexibility and dependability in the stoker, which must provide an instant inrush of heat to maintain pressure on the upswing . . . and must cut off cleanly to prevent boiler popping on the downswing.

Prior to installation of a Westinghouse Centrafire® with Link-Grate, the hammermen were starved for steam . . . were handicapped and slowed down in working the metal; costly reheats were often required. Boiler popping lost expensive steam to the atmosphere.

The Westinghouse Centrafire with Link-Grate, however, has ended these troubles. It follows the load . . . up or down . . . with a flexibility characteristic of the Centrafire. Moreover, with steam flow cut to zero for up to six hours between shift changes, the Centrafire holds the fire. And . . . there has been no forced shutdown of this unit since its installation.

You can have the flexibility . . . the reliability . . . the low operating and maintenance costs of a Westinghouse Stoker with any boiler of your choice. A Westinghouse Stoker Application Engineer is as near to you as your telephone . . . or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Penna. J-50529

YOU CAN BE SURE . . . IF IT'S
Westinghouse
STOKERS



FAIRBANKS-MORSE DIESELS CAN HELP SOLVE YOUR

Power Puzzle

Power in most manufacturing is a major charge against unit costs. With a continuing rise in labor and material costs, power becomes the one factor that presents a possibility for important savings.

But, the question is—How, in your plant?

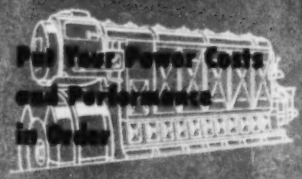
Listed here are a few of the ways Fairbanks-Morse Diesel power generation can help solve your problem. These are *proved* answers based on more than 50 years' experience in the power generation field.

If power has you puzzled, write us today, outlining your needs. Fairbanks-Morse engineering can help put your power costs and performance in order. Fairbanks, Morse & Co., Chicago 5, Illinois.

FAIRBANKS-MORSE

a name worth remembering

DIESEL AND DUAL FUEL ENGINES • DIESEL LOCOMOTIVES • ELECTRICAL MACHINERY • PUMPS • SCALES • RAIL CARS • MAGNETOS • FARM MACHINERY



Put Your Power Costs and Performance in Order

1 ***Handle Peak Demand*** . . . reduce peak demand values for lower purchased power cost.

2 ***Raise Power Factor*** . . . "in-plant" generation can eliminate power factor penalties.

3 ***Emergency Power*** . . . insurance against lost production, damage due to line failures.

4 ***Handle Surge Loads*** . . . that may now be affecting current characteristics of entire plant.

5 ***Plant Expansion*** . . . need not be restricted due to lack—or expense—of ample power.

6 ***Useful Heat*** . . . lube oil, water and exhaust heat can cut drying and heating costs.

7 ***Chemical Value*** . . . exhaust gases are high in nitrogen—available for economical fixation of nitrates, ammonia.

8 ***Insurance Advantage*** . . . of diesel over gasoline engine, for example, will soon pay for installation.

9 ***No Weather Worries*** . . . ice, snow, sleet, wind storms can't stop plant operations.

10 ***Handle Increasing Load*** . . . "in-plant" power economically adds to current capacity as load increases.

11 ***Fuel Economy*** . . . use diesel oil, natural gas or sewage gas for added economy.

12 ***Remote Locations*** . . . distance from transmission lines needn't curtail planned plant expansions.

13 ***Compact Power*** . . . Fairbanks-Morse engines give you more power per foot of floor space, more power on present foundation.

14 ***Minimum Attendance*** . . . Fairbanks-Morse "in-plant" generating sets require minimum supervision and maintenance.

15 ***Save Cost*** . . . of running in new line where present transformers and power lines are already loaded.

LINE-O-POWER STRAIGHT LINE DRIVES
FOOTE BROS.—LOUIS ALLIS GEARMOTORS
HYGRADE HORIZONTAL WORM GEAR DRIVES
MAXI-POWER HELICAL GEAR DRIVES
VERTICAL WORM-HELICAL GEAR DRIVES

DRIVES *for every power transmission need...*

Whatever your requirements in enclosed gear drives, you will find the one best suited to your needs in the complete Foote Bros. line.

Here are compact gearmotor and speed reduction units, ideal for use on original equipment. Heavy duty worm gear drives designed to stand up under tough service. Helical gear drives available in capacities of over 1500 h.p.

The latest in gear-cutting equipment, newest manufacturing techniques, better control of material—all backed by nearly a century of experience—assure you high quality enclosed gear drives.

Bulletins are available on drives to meet every need. Check the ones you want on the coupon below.

LINE-O-POWER STRAIGHT-LINE DRIVES

Economical in original cost and operation. Duti-Rated Gears have file-hard tooth surfaces and ductile cores, assuring long life. Double or triple reductions, with ratios from 5 to 1 up to 238 to 1 and capacity range from 1 up to 175 horsepower.

FOOTE BROS.—LOUIS ALLIS GEARMOTORS

A compact line of gearmotors in 17 sizes in single, double and triple reductions, incorporating Duti-Rated Gears that assure long wear life and maximum load-carrying capacity. Available with Louis Allis open drip-proof, splash-proof, enclosed and explosion-proof motors.

HYGRADE WORM GEAR DRIVES

Heavy duty drives with precision worm gearing that assures high efficiency and load-carrying capacity. Horizontal, vertical and Hytop (extended shaft) types. Ratios from 4⅛ to 1 up to 4108 to 1. Capacities up to 260 horsepower.

MAXI-POWER HELICAL GEAR DRIVES

Heavy-duty helical gear drives. Available in single reduction units, ratios up to 9.91 to 1; capacities up to 1550 horsepower; double-reduction units, ratios from 9.32 up to 71 to 1, capacities to 1100 horsepower; triple reduction units, ratios from 79 up to 360 to 1, capacities up to 420 horsepower.

WORM-HELICAL GEAR DRIVES

Heavy duty vertical drives with horizontal input shafts and vertical output shafts—up or down. Ratios from approximately 25 to 285 to 1 and a capacity range up to 128 horsepower.

FOOTE BROS.

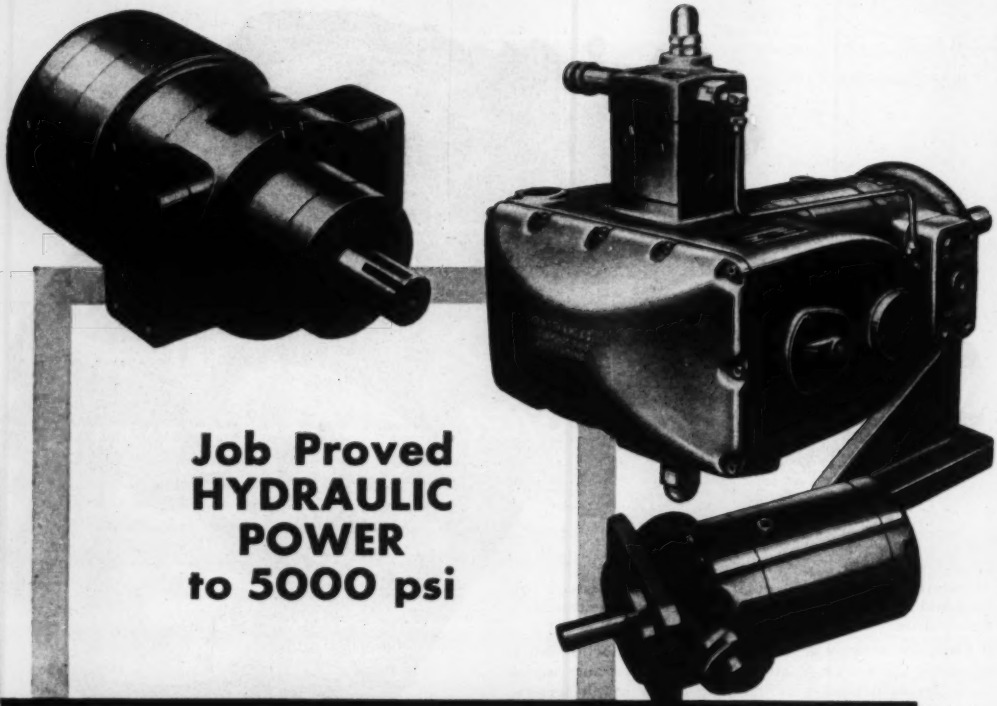
Better Power Transmission Through Better Gears

FOOTE BROS. GEAR AND MACHINE CORPORATION
4545 South Western Boulevard • Chicago 9, Illinois

FOOTE BROS. GEAR AND MACHINE CORPORATION
Dept. Q, 4545 South Western Boulevard, Chicago 9, Illinois

- ☐ Bulletin HGA Hygrade Worm Gear Drives
- ☐ Bulletin LPB Line-O-Power Straight Line Drives
- ☐ Bulletin MPB Maxi-Power Helical Gear Drives
- ☐ Bulletin GMA Foote Bros.—Louis Allis Gearmotors
- ☐ Bulletin WHA Worm-Helical Gear Drives

Name.....*Position*.....
Company.....
Address.....
City.....*Zone*.....*State*.....



Job Proved HYDRAULIC POWER to 5000 psi

Denison High-Pressure Axial Piston PUMPS

Denison High Pressure Axial Piston Pumps have received unqualified approval on countless high pressure applications—industrial, oil, field construction, marine, automatic, and ordnance.

Their powerful, compact construction features hydraulic balance throughout . . . elimination of thrust bearings . . . improved shaft construction that absorbs deflection and compensates for external shaft loads or coupling misalignment. Space-saving design, with a choice of face, flange and foot mountings, simplifies installation. The advantages of Denison hydraulic pumps can be *proved by comparison* on your job. Write for full information.

GET MORE POWER FOR YOUR MONEY

- Constant or Variable Volume
- Stem, Cylinder, Handwheel or Compensator Control
- Volume Capacities to 35 gpm
- Rugged, Axial Piston Design
- Hydraulically Balanced Throughout

SEND FOR BULLETINS ON DENISON PUMPS AND CONTROLS TO FIT YOUR NEEDS

The DENISON Engineering Co.
1189 Dublin Road, Columbus 16, Ohio

DENISON HydrOILics

Have you investigated the new Denison Vane-Type Pump/Motor?

Remember — the trade marks "tt" and "TUBE-TURN" are applicable only to products of TUBE TURNS, INC.

Engineered for efficient flow

EFFICIENT FLOW in piping systems is worth striving for . . . it saves kilowatt-hours and avoids over-investment in equipment. That's why, on this TUBE-TURN Welding Elbow, so much engineering attention is devoted to true circularity, smooth inner walls, and exact radius. They all contribute to minimum flow resistance and reduced pressure loss.

When you specify TUBE-TURN Welding Fittings and Flanges you are specifying careful engineering. Get in touch with your nearby TUBE TURNS' Distributor. You'll find one in every principal city.

Write Dept. F-5 for free booklet "Pipe and Fitting Materials" which gives specifications, properties and welding procedures for various materials.

Be sure you see the double "tt"

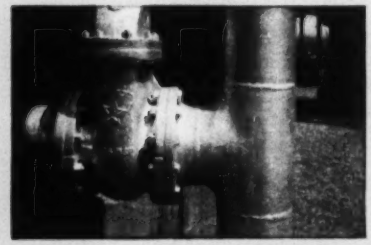
TUBE TURNS, INC. LOUISVILLE 1, KENTUCKY

DISTRICT OFFICES: New York • Philadelphia • Pittsburgh • Chicago • Houston • Tulsa • San Francisco • Los Angeles
TUBE TURNS OF CANADA LIMITED, CHATHAM, ONTARIO... A wholly owned subsidiary of TUBE TURNS, INC.

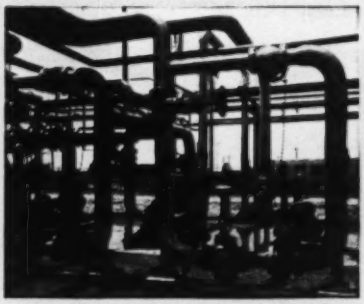
Where leakproof piping is imperative... TUBE-TURN Welding Fittings are on the job!

Design and installation of piping was simplified by obtaining all the necessary types of welding fittings from one reliable source. TUBE TURNS, INC. offers the world's broadest line of welding fittings and flanges—available in a wide range of types, sizes, and more than 40 different alloys.

Piping at new Mississippi Chemical Corporation plant handles explosive gases and acids at high pressures. That's why leakproof welded piping was specified, and TUBE-TURN Welding Fittings and Flanges used throughout. Process piping handles hydrogen, nitric acid, anhydrous ammonia, etc. Engineering and construction of entire plant, which produces synthetic nitrogen fertilizer, was handled by The Girdler Corporation.



125-lb. cast iron valve is secured to process line with TUBE-TURN Welding Neck Flanges. True circularity and uniform wall thickness of TUBE-TURN Welding Fittings, such as Welding Tee (right) and Welding Reducer (left) assure proper fit and speedy fabrication. Welders know they can depend on accurate line-up with TUBE-TURN Welding Fittings.



Welded piping using TUBE-TURN Welding Fittings keeps flow resistance and pressure drop to a minimum —an important consideration where so much piping is used. The complete Mississippi Chemical plant is noteworthy for high efficiency throughout . . . unit energy input is lower than in any other similar plant.

TUBE TURNS, INC., Dept. F-5
224 East Broadway, Louisville 1, Kentucky

Your Name .....
Position .....
Company .....
Nature of Business .....
Address .....
City ..... *State* .....

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"TT" and "TUBE-TURN" Reg. U. S. Pat. Off.

TUBE TURNS, INC.

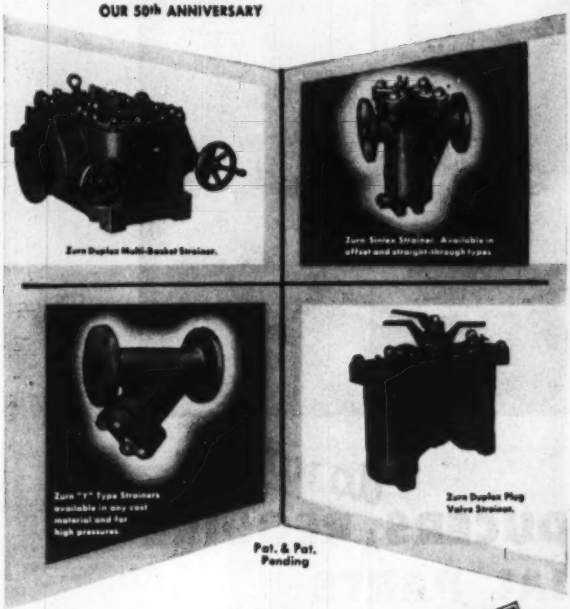
LOUISVILLE 1, KENTUCKY

ENGINEERED

To Permit High Rates of Flow With Remarkably Low Pressure Drop

ZURN LOW PRESSURE DROP STRAINERS

OUR 50th ANNIVERSARY


Zurn Duplex Multi-Basket Strainer.
Zurn Simplex Strainer. Available in offset and straight-through types.
Zurn "Y" Type Strainers available in any cast material and for high pressures.
Zurn Duplex Plug Valve Strainer.

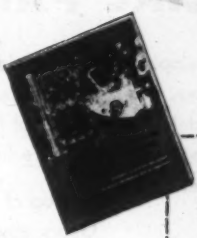
Pat. & Pat. Pending

IMMEASURABLY IMPROVE THE HANDLING OF FLUIDS (OIL, CHEMICALS, WATER) THROUGH PIPE LINES

Now, a reduction of pressure loss can be obtained by the installation of Zurn Engineered Strainers. Design improved for correct circularity, smooth inner walls combined with correctly sized and perforated baskets reduce pressure loss and afford maximum protection for all types of mechanical units connected with pipe lines.

Zurn Strainers, are held to close manufacturing tolerances for materials, shape, and dimensions assuring the utmost in strength and safety. Zurn Strainer applications include fluid handling lines for lubricating and fuel oil, and oil during the refining process; a wide range of chemicals produced and used by the various process industries; public utility power plants; power stations; industrial plants; municipal water systems; ships and high temperature, high pressure installations. Zurn Fluid Handling Engineers are available for consultation on your fluid handling problems.

Write for Pipe Line Strainer Manual No. 951, including previously unpublished pressure drop data.



J. A. ZURN MFG. CO.
INDUSTRIAL DIVISION • ERIE, PA., U. S. A.
In Canada: Canadian Zurn Engineering Ltd., Montreal, P. Q.

J. A. ZURN MFG. CO.
Industrial Division; Erie, Pa., U. S. A.
Please send me Pipe Line Strainer Manual No. 951

Name_____

Position_____

Company_____

Street_____

City_____ State_____

Please attach to your business letterhead—Dept. ME

Copyright 1952

Shown here are two reducers—a STANDARD, at left, a SPECIAL at right. Yet, except for the housing, parts are completely interchangeable.

SPECIAL REDUCERS do not REQUIRE SPECIAL PARTS

By specifying Cone-Drive DOUBLE-enveloping Gears when you need a special reducer, you can, in most cases, retain all the cost, delivery and reconversion advantages resulting from use of STANDARDIZED gears, shafts, bearings, carriers, etc.

This interchangeability applies whether the reducer is fin-cooled, water cooled or fan cooled. Except for gear and worm teeth, as a matter of fact, all reducers of the same center distance have interchangeable parts.

On top of that, when you specify Cone-Drive Gears, you get the remarkable compactness of DOUBLE-enveloping gearing at no extra cost.

Write today for the name of the Cone-Drive Gears Representative in your territory.

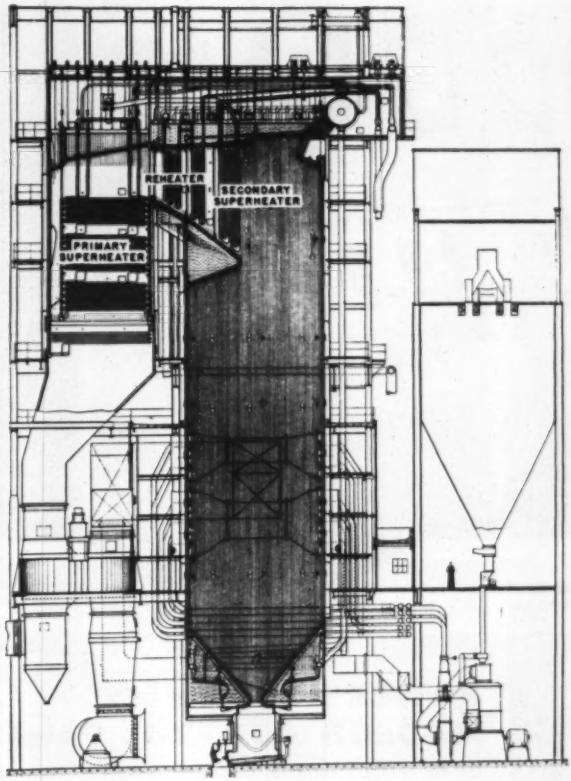
CONE-DRIVE GEARS
DOUBLE ENVELOPING GEAR SETS & SPEED REDUCERS

Division Michigan Tool Company
7171 E. McNichols Road • Detroit 12, Michigan

C-E REHEAT BOILERS

JOPPA STEAM STATION

ELECTRIC ENERGY, INC.



THE C-E Unit, illustrated here, is one of four such units now in process of fabrication for Electric Energy, Inc., near Joppa, Illinois.

Each of these units is designed to serve a 125,000/156,000 kw turbine-generator operating at a throttle pressure of 1800 psi with a primary steam temperature of 1050 F, reheated to 1000 F.

The units are of the radiant type with a reheater section located between the primary and secondary superheater surfaces. Economizer surface is located below the rear superheater section and regenerative-type air heaters follow the economizer surface.

The furnaces are fully water cooled using closely spaced tubes. They are of the basket-bottom type, discharging to sluicing ash hoppers.

Pulverized coal firing is employed, using bowl mills and tilting, tangential burners. Provision is made to use oil and natural gas as alternate fuels. B-544

C-E

COMBUSTION ENGINEERING—SUPERHEATER, INC.

200 Madison Avenue • New York 16, N. Y.

ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS

POWERS for Heating and

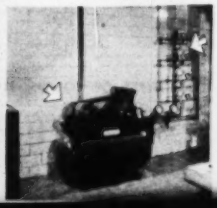
PNEUMATIC CONTROL SYSTEMS

POWERS Design for MODERN CONTROL PANEL

In the unique functional design of this Control Panel are integrated various types of POWERS pneumatic controlling, indicating and recording instruments. It masterminds the operation of four complete year round air conditioning systems in the modern plant shown on the next page.

Photos at left and top and bottom of next page show air conditioning systems regulated by the Control Panel. Arrows indicate Powers controls.

Photo below, left—shows four refrigerator compressors, one for each air conditioning system; photo right—Powers air compressor and pilot valves supplying air pressure for control system.



Air Conditioning

Increase Production
Improve Products–Lower Costs

Room Thermostat for Offices

POWERS TEMPERATURE and HUMIDITY CONTROL SYSTEMS prevent OVER-heated air in process rooms, laboratories, offices and other spaces. Comfortable, healthful room temperature — not only increases output of workers, but—

★ **Cuts Heating Costs up to 25%**—Keeping each room at its proper temperature prevents waste of fuel from OVER-heating. With todays much higher fuel costs, bigger savings than ever before are now possible with Powers control.

Constant Temperature and Humidity conditions in each room can be maintained at any predetermined point with Powers control. It can be installed in existing as well as new buildings.

25 to 40 Years of Dependable Service with very low maintenance cost is reported by hundreds of users. Powers control is notable for its continuous accurate performance.

Precision Control for Processes—Wherever product uniformity and quality are dependent upon precise temperature and humidity regulation, use Powers controlling, indicating or recording instruments.

New modern plant commemorating 60th anniversary of The Powers Regulator Co., pioneer in pneumatic operated controls for heating, air conditioning systems and industrial processes.

Phone or write our nearest office for help in selecting the type of automatic control that will give best results for your requirements. There's no obligation.

THE POWERS REGULATOR CO.

Established 1891 • SKOKIE, ILLINOIS • Offices in Over 50 Cities

CHICAGO 13, ILL., 3819 N. Ashland Ave. • NEW YORK 17, N. Y., 231 E. 46 St.
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DETROIT 1, MICH., 2631 Woodward Ave. • TORONTO, ONT., 195 Spadina Ave.
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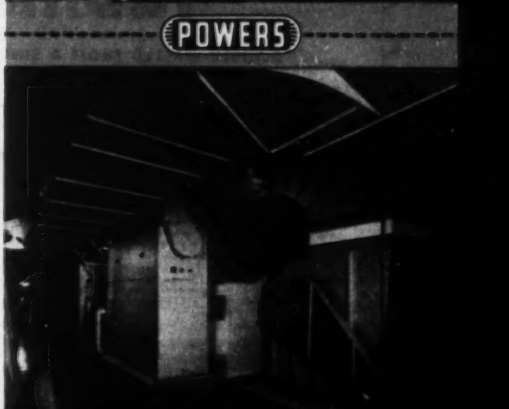
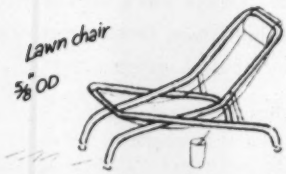
(a83c)



Bundyweld "Doodles"

to jog a designer's imagination

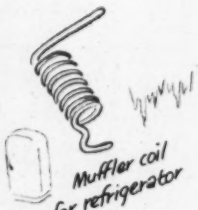
Frame for golf-bag cart
5/8" OD x .049



Lawn chair
5/8" OD

Put Bundyweld Tubing into that part of yours and get improved performance. Put Bundyweld through your production lines and get lowered fabrication costs.

If you need design or fabrication help, depend on Bundy skills, the industry's finest, to save you time, materials, money. If you choose, have Bundy fabricate and ship your parts—in any quantity and on time. Write for catalog today. ***Bundy Tubing Company, Detroit 14, Michigan.***



Muffler coil for refrigerator

Radiant heating coil

Bundyweld® Tubing

DOUBLE-WALLED FROM A SINGLE STRIP

Leakproof
High thermal conductivity
High bursting point
High endurance limit
Extra-strong
Shock-resistant
Ductile

Lightweight
Machines easily
Takes plastic coating
Scale-free
Bright and clean
No inside bead
Uniform I.D., O.D.

WHY BUNDYWELD IS BETTER TUBING

Bundyweld starts as a single strip of copper-coated steel. Then it's . . .

continuously rolled twice around laterally into a tube of uniform thickness, and

passed through a furnace. Copper coating fuses with steel. Presto . . .

Bundyweld, double-walled and brazed through 360° of wall contact.

← **NOTE** the exclusive patented Bundyweld beveled edges, which afford a smoother joint, absence of bead and less chance for any leakage.

Bundy Tubing Distributors and Representatives: Cambridge, 42, Mass.: Austin-Hastings Co., Inc., 226 Binney St. • **Chattanooga 2, Tenn.:** Poirson-Deakins Co., 823-824 Chattanooga Bank Bldg. • **Chicago 32, Ill.:** Lapham-Hickey Co., 3333 W. 47th Place • **Elizabeth, New Jersey:** A. B. Murray Co., Inc., Post Office Box 476 • **Philadelphia 3, Penn.:** Ryan & Co., 1717 Sansom St. • **San Francisco 10, Calif.:** Pacific Metals Co., Ltd., 3100 19th St. • **Seattle 4, Wash.:** Eagle Metals Co., 4755 First Ave. South **Toronto 3, Ontario, Canada:** Alloy Metal Sales, Ltd., 881 Bay St. • **Bundyweld nickel and Monel tubing is sold by distributors of nickel and nickel alloys in principal cities.**

WELDING FITTINGS ON YOUR MIND

It will pay you to think of Midwest whenever you think of welding fittings. For example: the variety of elbows offered only by Midwest provides greater latitude in piping design and permits improvements and economies not otherwise possible.

Same radius as ASA but tangent equal to 25% of nominal pipe size on each end. Saves pipe, layout and welding time. Costs no more than ASA. Sizes to 24".

Dimensions conform to applicable size range of American Standard for Butt-Welding Fittings, ASA B16.9. Tolerances much less than allowable. Sizes to 26".

Recommended where space limitations do not permit use of "Long Tangent" or ASA Elbows. Sizes to 36".

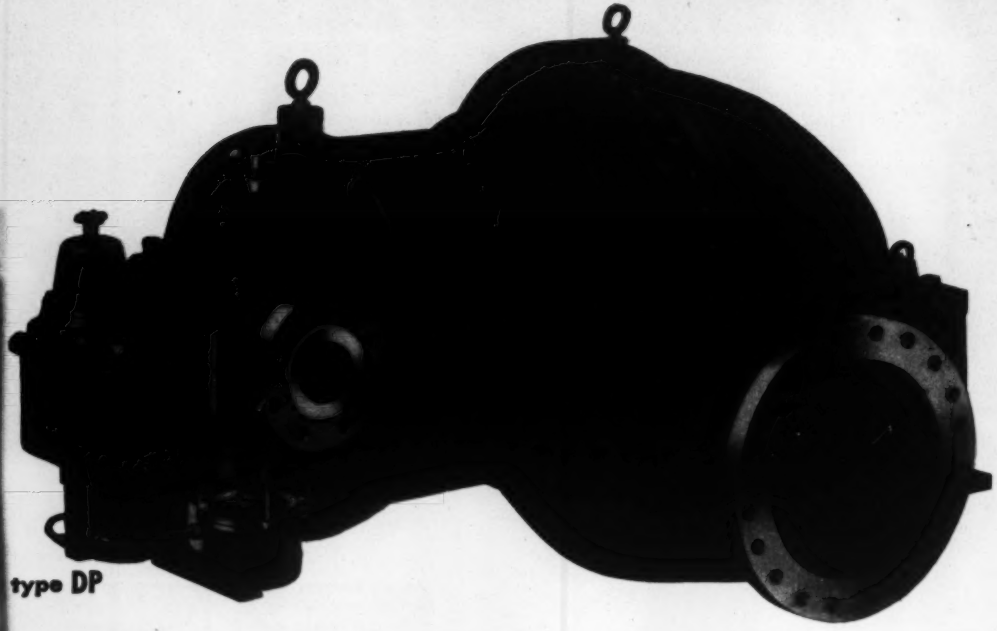
Takes the place of a straight size elbow and a reducer. Eliminates one weld, reduces pressure drop, easier to maintain. Sizes to 12", reductions to half size.

MIDWEST
PIPING & SUPPLY CO., Inc.

Main Office: 1450 South Second Street, St. Louis 4, Mo.
Plants: St. Louis, Passaic, Los Angeles and Boston
Sales Offices: New York 7—50 Church St. • Chicago 3—79 West Monroe St.
Los Angeles 33—520 Anderson St. • Houston 2—1213 Capitol Ave.
Tulsa 3—224 Wright Bldg. • Boston 27—426 First St.

General Electric Announces

A NEW ADVANCE IN



type DP

Custom Performance from Standard Turbine Drives now possible through new Designs and Manufacturing Methods

Now you can select the mechanical-drive turbine that will give you maximum mechanical power for your fuel dollar . . . and without the delay and expense of special engineering. General Electric's four new multi-stage drives are *standards,* designed to meet your *specific* requirements.

Four new governing systems give you a wide selection of performance ratings. A new sectional valve gives you greater efficiency for part load operation. Many other improvements make these the finest turbines of their size General Electric has ever produced.

Secret of their adaptability is in the method of manufacture. By using interchangeable casting patterns, designed to be combined in a variety of ways, it's possible for the factory to "customize" standard machines for individual applications. You get a better turbine, designed for your job, and the delivery time is shorter, the cost lower.

Get the full particulars on these new multi-stage turbine drives. Write for our new bulletin, GEA-5580, "G-E Multi-Stage Turbine Drives." General Electric Company, Section 252-53, Schenectady, N. Y.

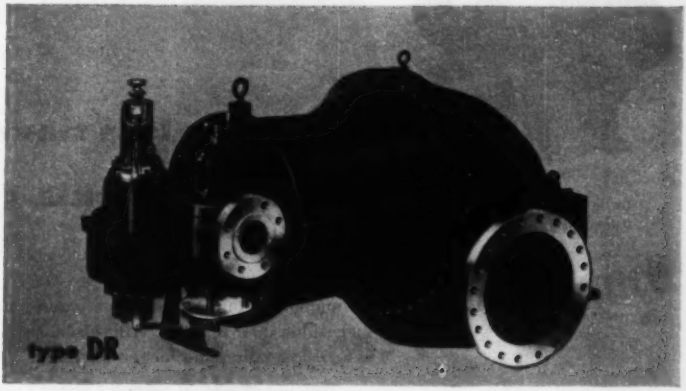
GENERAL ELECTRIC

252-53

MULTI-STAGE TURBINE DRIVES

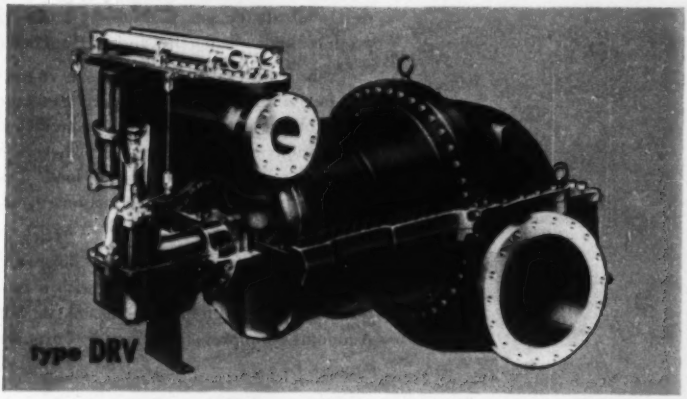
type DP

Dependable power over a 30 per cent adjustable speed range.



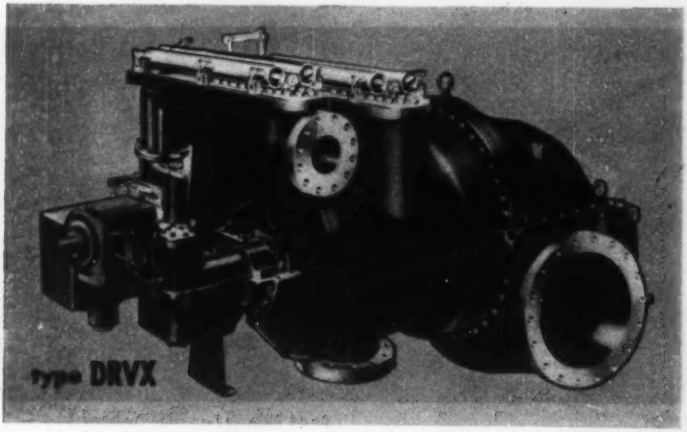
type DR

Oil-relay governor makes possible a speed range of 6 to 1, with only 4 per cent regulation and ½ per cent steady state speed variation.



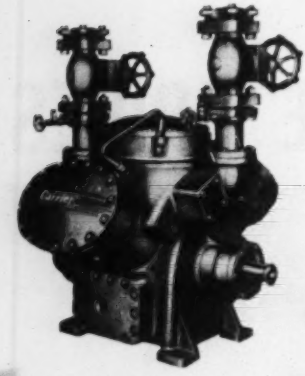
type DRV

Automatic sectional valves linked to the oil-relay governor minimize throttling losses under fluctuating load factors, make possible substantial operating savings.



type DRVX

For applications where process steam is desired at a definite, steady pressure. Extracted steam pressure remains constant even when load on the unit fluctuates and the flow of extracted steam varies.



Carrier Ammonia
Reciprocating Compressor

How do valves travel in a modern ammonia compressor?

. . . on cushions. An exclusive feature on our modernized line of ammonia compressors traps part of the gas behind the valves to cushion their opening. This cushion-smoothness for valves means quieter operation and longer valve life.

Another important item in Carrier's new line is the aerodynamic design of all the gas passageways, valve ports and valve discs to produce high efficiencies and low operating costs . . . at *all* loads.

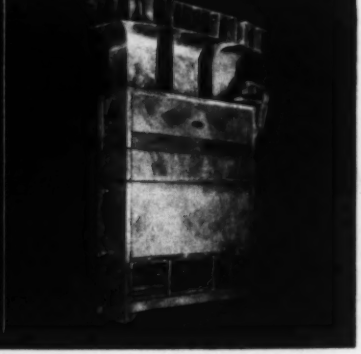
New features like these plus a rugged streamlined crankcase, laid out to make all wearing parts easily accessible, create a heavy-duty compressor with minimum weight and space requirements. Foundations are less expensive. There's greater flexibility of location with respect to refrigeration load. Less piping is required and installation is easier, with reductions in hauling, rigging, and other labor costs.

And to keep maintenance costs down, all parts are precision-made, renewable and interchangeable with a minimum of down-time, requiring no special tools or skills. Write for literature on the Carrier Ammonia Compressors. Carrier Corporation, Syracuse 1, N. Y.

Carrier

AIR CONDITIONING
REFRIGERATION
INDUSTRIAL HEATING

Carrier Ammonia Evaporative Condenser



Carrier Ammonia Cold Diffuser

WORM GEARING—universal in its application—affords advantages for almost every power transmission job. Select worm-gear units to meet your need—small or large—from the complete line of Cleveland Worm Gear Speed Reducers. For detailed information, diagrams and rating tables on standard small Clevelands now available, write for our Bulletin 114.
Photo by courtesy of Continental Foundry & Machine Company.

CLEVELAND drive gives continuous performance

SLAB shears, working round the clock today, must have dependable drives. That's the reason so many of them—as with the Continental downcut shear and gauge shown here—are equipped with Clevelands.

In the production and fabrication of steel, Cleveland Worm Gear Speed Reducers and Worm Gearing operate a wide variety of equipment—from car dumpers and ore bridges right through the mills to heat-treat furnaces, finishing presses and loading-out cranes. In fact, wherever any industry needs a powerful, quiet, trouble-free right-angle drive, you're likely to find a Cleveland at work.

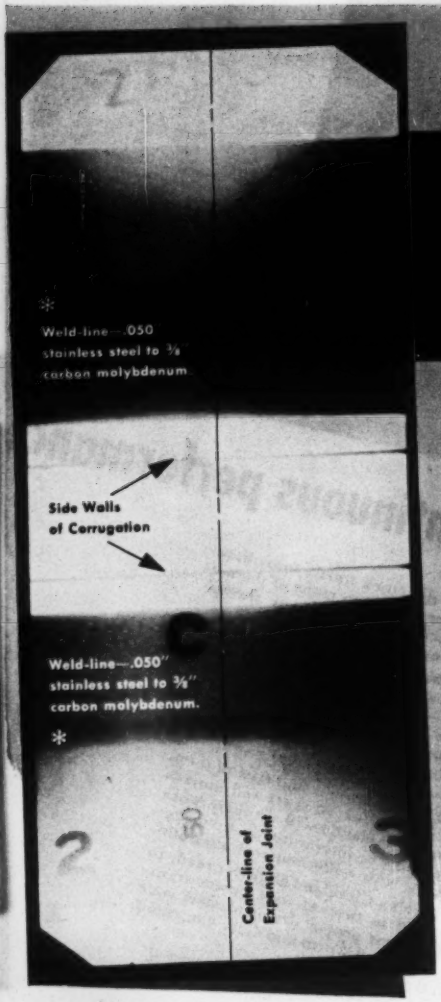
Wherever Clevelands serve—and you'll find tens of thousands of them on the job—many for 30 years and more—engineers will tell you that Clevelands will do their work under heavy loads, continuously or intermittently, no matter how severe the conditions, with a minimum of attention.

In or near your city, there's a Cleveland engineer ready to serve you. He will be glad to discuss your power transmission problems and suggest proper drives to meet your particular needs. The Cleveland Worm and Gear Co., 3264 East 80th Street, Cleveland 4, Ohio.

Affiliate: The Farval Corporation, Centralized Systems of Lubrication. In Canada: Peacock Brothers Limited.

HERE'S WHY...

you can't buy a better Expansion Joint than a ZALLEA


Weld-line—.050 stainless steel to ⅜ carbon molybdenum
Side Walls of Corrugation
Weld-line—.050" stainless steel to ⅜" carbon molybdenum.
Center-line of Expansion Joint

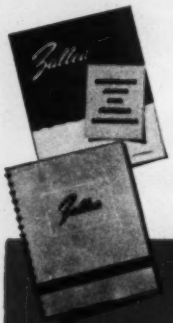
When the U. S. Navy specified use of 180 Zallea Welding Type 347 Stainless Steel Expansion Joints for a steam pipe installation on a new type vessel, job requirements included X-ray examination of all joint-to-pipe welds (.050" stainless steel to ⅜" carbon molybdenum seamless pipe).

This was a rigid test, since the revealing eye of the X-ray would immediately ferret out the slightest defect or trace of slag inclusion that might cause failures at welds after the pipe line went into service.

But when X-rayed, *not one* of the 360 Zallea welds disclosed any flaws or slag inclusion! In reporting test results, the independent industrial laboratory making the examination wrote: "*We have never seen more perfect welds under X-ray.*"

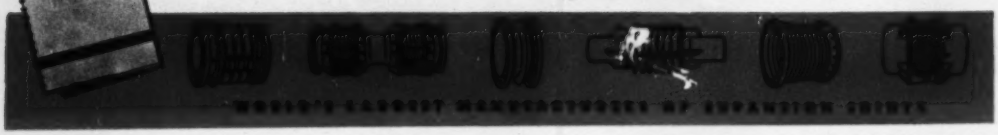
The exclusive Zallea *controlled* welding technique used on this job is the same technique applied in the manufacture of every Zallea Expansion Joint that leaves our plant. It's your assurance that when you buy Zallea Expansion Joints, you buy the best. They're better built . . . last *far* longer. So next time you consider expansion joints, specify Zallea . . . you'll find it pays!

Zallea Expansion Joints are available in diameters from 3 inches to 30 feet for temperatures from sub-zero to 1600° F . . . for pressures from vacuum to 300 psi in standard designs and up to 2000 psi in special designs. Zallea Brothers, 820 Locust Street, Wilmington 99, Delaware.



Write today for Catalog 47 and Bulletin 331 which illustrate all Zallea Expansion Joints.

Zallea
EXPANSION JOINTS



PUTTING IT ON THE LINE...

in Industry after Industry!

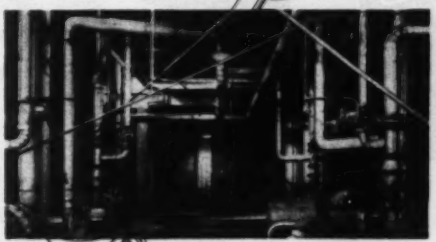
The Grinnell-Saunders Diaphragm Valve . . . . . .

Here's why . . . Piping in today's complex industrial plants is an exacting science involving the handling of highly corrosive fluids, gases, compressed air, beverages, foods and suspended solids . . . in lines where corrosion, abrasion, contamination, clogging, leakage and maintenance are costly factors. Under such conditions, the amazing adaptability of the Grinnell-Saunders Diaphragm Valve explains its acceptance by industry after industry.

Bodies of this versatile valve are made in a variety of metals — iron, stainless steel, bronze, aluminum and others. *But of more importance* is the fact that a body of cast iron (a metal not in short supply) can be lined with glass, lead, natural rubber, neoprene and other materials which, in many instances, handle corrosive fluids *better* than metals.

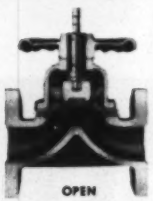
Diaphragms come in natural rubber, neoprene, butyl, hycar, a special synthetic for foods, and KEL-F. This last is chemically inert to all acids and alkalies in all concentrations with the exception of molten alkali metals.

From this broad selection of materials, the problems which the Grinnell-Saunders valve can solve are extremely varied. No wonder industry after industry is putting it on the line.



PULP AND PAPER MILL. Rubber-lined Grinnell-Saunders Valves on stainless steel piping handle sulphate pulp stock in bleach plant of Potlatch Forests, Inc., Lewiston, Idaho.

CHEMICAL PLANTS. Glass-lined Grinnell-Saunders Diaphragm Valves, with KEL-F diaphragms, handle chlorinated organic chemicals at Hooker Electrochemical Company, Niagara Falls, N. Y.



OPEN

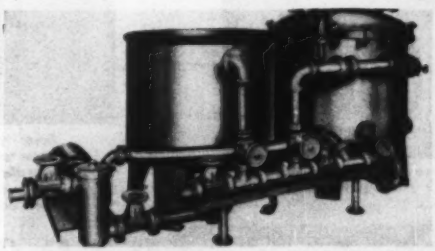
CLOSED

Showing rising spindle . . . valves are available with rising or stationary spindle.

KEL-F diaphragm, using special rubber backing cushion and floating tube nut design.

CHECK THESE GRINNELL-SAUNDERS FEATURES...

- Diaphragm absolutely isolates working parts from the fluid.
- Diaphragm lifts high for streamline flow in either direction.
- Diaphragm presses tight for positive closure.
- Body, lining and diaphragm materials to suit service.
- Simple maintenance — diaphragm easily replaced.



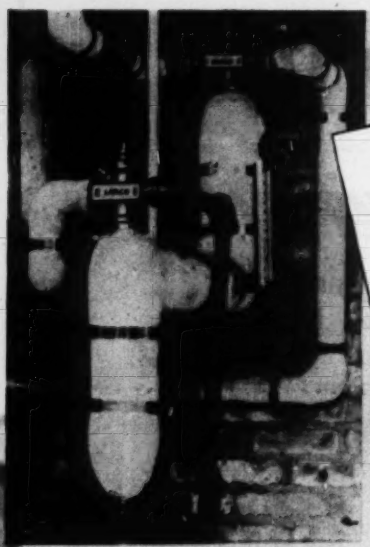
EQUIPMENT MANUFACTURERS. Grinnell-Saunders valves with rubber linings are standard on filtration equipment for solution clarification, made by Industrial Filter & Pump Mfg. Co., Chicago, Ill.

GRINNELL

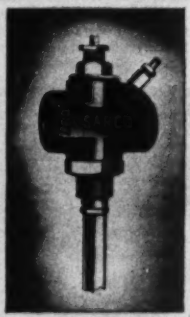
WHENEVER PIPING IS INVOLVED

Grinnell Company Inc., Providence, Rhode Island • Sales Offices and Warehouses in Principal Cities

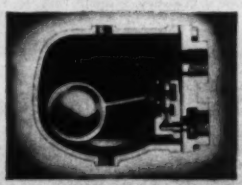
pipe and tube fittings • welding fittings • engineered pipe hangers and supports • Thermolier unit heaters • valves
Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies
industrial supplies • Grinnell automatic sprinkler fire protection systems • Amco air conditioning systems



Sarco makes simple, self-acting temperature controls assuring the desired Jacket cooling effect with minimum water consumption regardless of load variations.



Sarco type TR-40-L Cooling Control-Jacket water temperatures never too hot or too cold.



Sarco type FA Drain Traps have four pressure ranges to 750 psi. Sizes: ¾" or 1".

IS YOUR AIR COMPRESSOR CAPACITY EFFECTIVE?

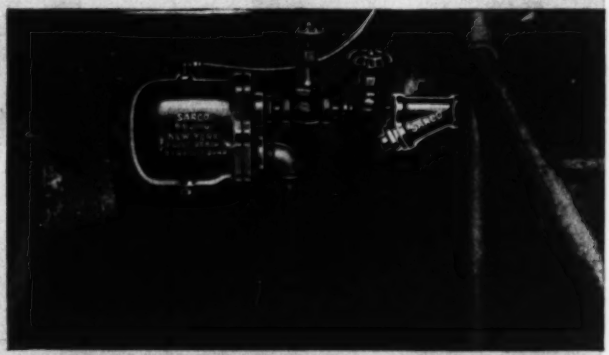
The true measure of effective air compressor capacity is the useful work done by your compressed air.

Measured by this yardstick, many compressor installations are very much oversize for the work they do.

Apart from poorly designed piping, the trouble usually lies in wet air, overcooling, undercooling, choked intake filters, etc. All of these things add up to expensive compressed air and high maintenance costs.

New Technical Bulletin, No. 5-CA, is designed to help users and would-be users of compressed air to get more work from their machines at less cost.

Write for your free copy today.



Sarco type FA compressed air trap automatically removes separated water from the bottom of the receiver. This greatly reduces the possibility of water being carried down the distribution lines to cause trouble in the tools or at the air nozzles. This trap is also used to drain water from separators and the low points of distribution lines.

343

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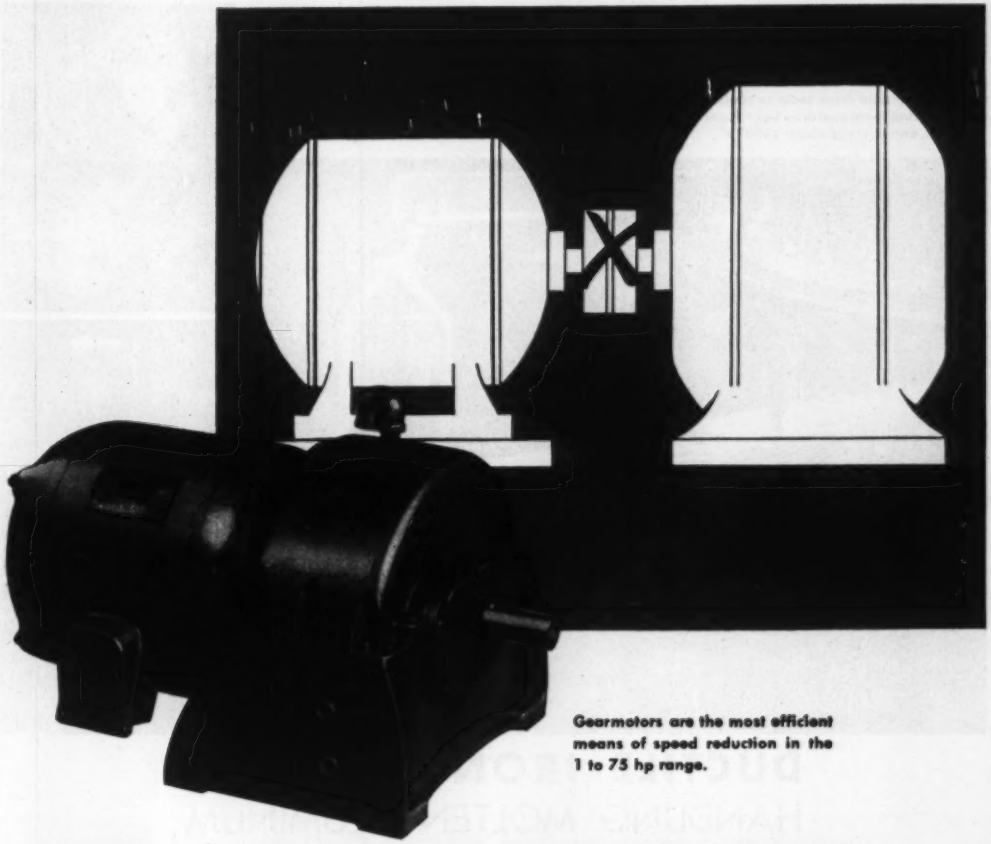
EMPIRE STATE BUILDING, NEW YORK 1, N. Y.

Represented in Principal Cities

SARCO CANADA LTD., TORONTO 5, ONTARIO



Gearmotors are the most efficient means of speed reduction in the 1 to 75 hp range.

Small size and unit construction simplify mounting of Life-Line GEARMOTORS

Gearmotors provide the ultimate in compactness. Life-Line Gearmotors give you this compactness, plus many exclusive features not available in any other make. When mounting space is at a premium—Life-Line Gearmotors simplify the problem.

They are self-contained . . . can be installed quickly and conveniently. There's no handling, mounting and aligning of a separate motor, coupling and subbase or bedplate.

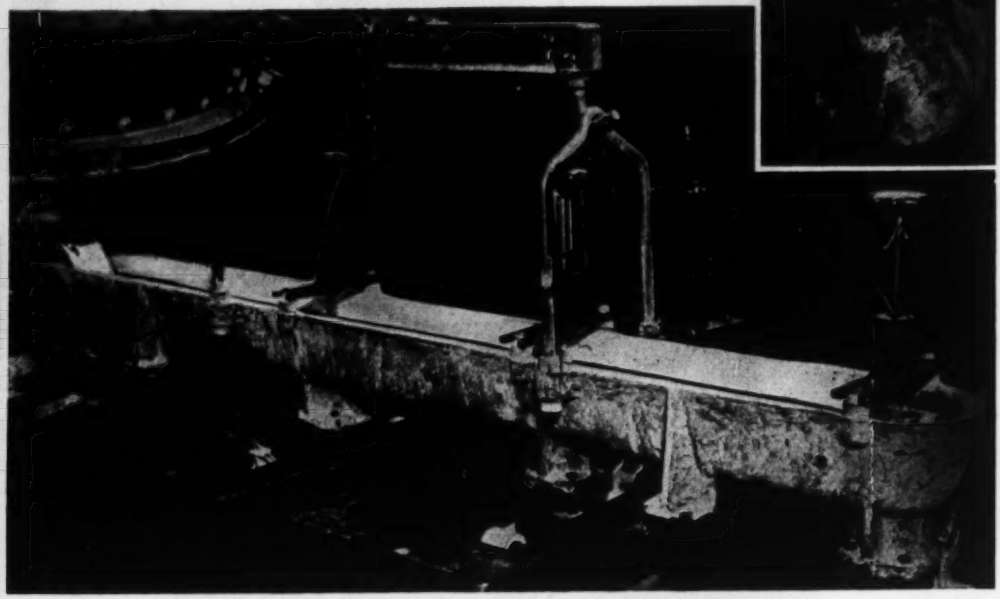
Life-Line Gearmotors also offer you these advantages: fewer moving parts, require less maintenance—are easier to inspect and service—are designed, built and serviced by ONE manufacturer.

Use the most efficient means of speed reduction. Use Life-Line Gearmotors. Call your Westinghouse representative for the facts, or write to Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania.

J-07310

BEFORE UTILIZING DUCTILE IRON . . . trough failures usually occurred at down spouts, progressively cracking through flanges. Flanges also warped, throwing bolt holes out of line.

DUCTILE IRON TROUGH . . . channeling molten aluminum from ladle to multiple casting unit. Pouring temperatures vary from 1250° to 1400° F., and average about 1300° F.



DUCTILE IRON TROUGHS
HANDLING MOLTEN ALUMINUM
Last 6 times longer!

DUCTILE IRON RESISTS OXIDATION AND GROWTH to an extent never before available in gray iron castings...

The photograph above shows one of two Ductile Iron pouring troughs that have been giving virtually continuous service for more than 18 months ... five days a week, 24 hours a day ... in the Aluminum Company of America plant at Edgewater, N. J. In contrast, the formerly used gray iron troughs had an average life of only three months.

27,000,000 pounds of molten aluminum have been poured with the two Ductile Iron troughs produced by Sacks-Barlow Foundries of Newark, N. J.

Ductile Iron is being used extensively at elevated temperatures, because of its exceptional resistance to oxidation and heat effects. The rapidly growing list of applications include: reduction pots, forging furnace door frames, sintering machine grate bars, lifting plates for coil annealing machines, lifter bars in rolling mills, and scores of engine, furnace and other parts subjected to heat.

Request a list of available publications on Ductile Iron ... mail the coupon now.

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MECHANICAL ENGINEERING

Published by The American Society of Mechanical Engineers

VOLUME 74 NUMBER 5

Contents for May, 1952

OPERATING EXPERIENCES WITH CYCLONE-FIRED STEAM GENERATORS . . . . . *V. L. Stone and I. L. Wade* 359
PROPERTIES OF SOME HEAT-RESISTANT ADHESIVES . . *C. W. Roush and A. J. Kearfott* 369
OPERATING EXPERIENCE OF THE TALGO TRAIN . . . . . *A. W. Clarke* 375
THE TRANSIT VAN SYSTEM OF TRANSPORTATION . . . . . *J. R. Alison* 377
OPERATING EXPERIENCES WITH STATIONARY GAS TURBINES . . . . . *P. R. Sidler* 381
HOW TO INCREASE PRODUCTIVITY IN SMALL PLANTS . . . . . *F. K. Shallenberger* 384
CONSERVATION OF MANPOWER AND MATERIALS . . . . . *H. H. Anderson* 389

EDITORIAL 357
BRIEFING THE RECORD 392
ASME TECHNICAL DIGEST 405
CONTENTS OF ASME TRANSACTIONS . . 411
COMMENTS ON PAPERS 412
REVIEWS OF BOOKS 413
BOOKS RECEIVED IN LIBRARY . . . 414
ASME BOILER CODE 415
ASME NEWS 416
ASME JUNIOR FORUM 437
ENGINEERING SOCIETIES PERSONNEL SERVICE . . . 438

CLASSIFIED ADVERTISEMENTS 140
CONSULTANTS 148
ADVERTISERS 150

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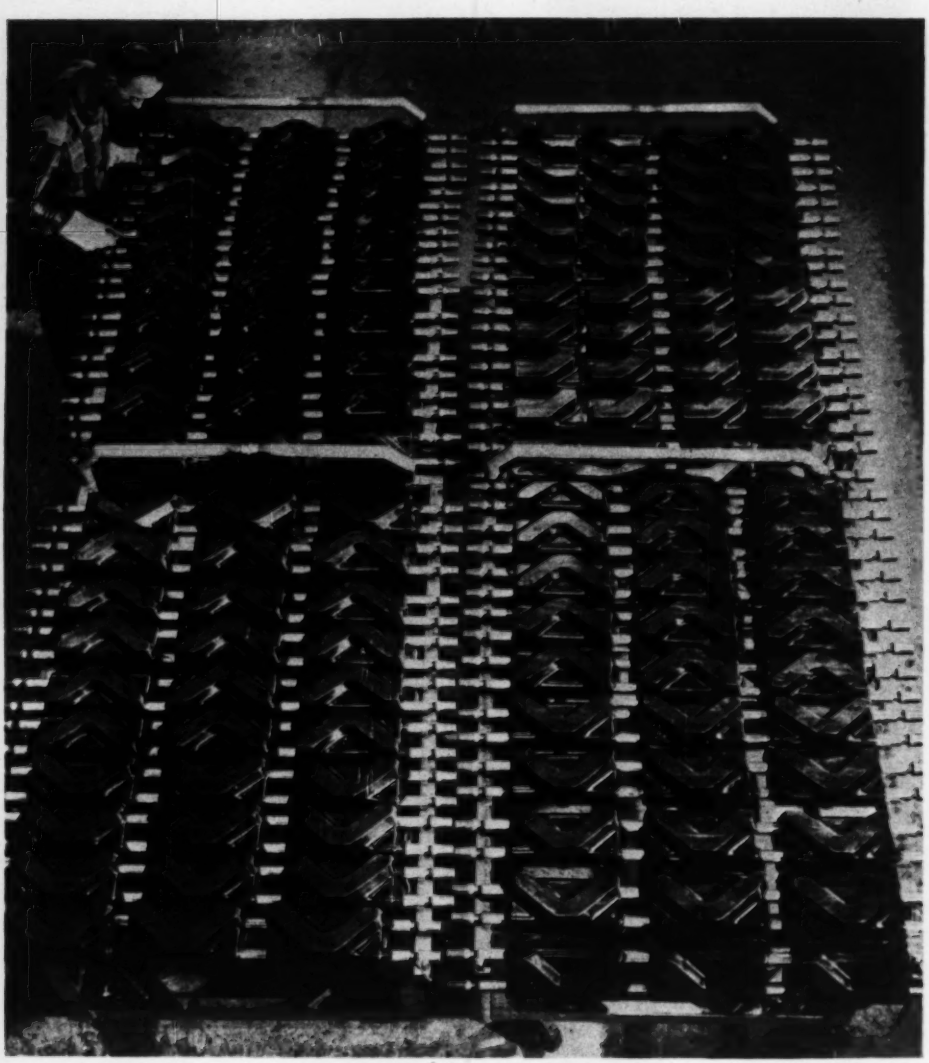

"Chevron" Rubber Tracks

(Manufactured for replacements on the M-26 "Pershing" and the M-46 "Patton" tanks at The B. F. Goodrich Company, Akron, Ohio)

VOLUME 74
No. 5

MECHANICAL ENGINEERING

MAY
1952

GEORGE A. STETSON, *Editor*

Centennial of Engineering

IT is a broad and fundamental concept on which the planners of the Centennial of Engineering have based their program for the Convocation to be held in Chicago, Sept. 3 to 13, 1952. In a series of public addresses they propose to demonstrate the contributions which engineering has made to our national progress. They will direct our attention to such fields as food, shelter, tools, communication, transportation, materials, energy, health, education, and professional-society development. These are fields in which man, by exercising his industry and intelligence, has been able to modify his natural environment and to utilize and adapt the resources abundant in nature to his own advantage.

The history of the human race is the history of the age-long struggle of man with his environment. Long as this history is, the progress recorded in the past hundred years seems to us to have acquired the most rapid acceleration toward the goals which have always brightened men's visions of abundance, security, and freedom. That those one hundred years have recorded the most rapid advances in engineering may provide grounds for claiming a considerable measure of credit for engineering in the achievement of noteworthy progress in the improvement of man's material well being. It may also raise the hope that we are on the verge of continued progress even in the advancement of human values, in the enhancement of human dignity, and in the growth and virility of freedom.

Life in the United States in 1852, the year of the founding of the American Society of Civil Engineers, was rich in opportunity and accomplishment. The nation, already vast in the extent of undeveloped land and natural resources, had expanded its frontiers to the Pacific Ocean. The discovery of gold in California was stimulating a westward migration of hardy pioneers and adventurers. Travel was slow and difficult. The era of canals had reached its zenith and that of rail transportation was beginning. On sea, river, and lake the sail was giving way to steam. Untold acres of farmland, never before under cultivation, were being developed. The invention of the cotton gin had increased the wealth of the planters in the South, and native ingenuity was blossoming into invention and industry in the North. For more than two centuries shipload after shipload of people from England and Europe had come to a New World to enjoy the opportunities it offered them. The disheartened, the oppressed, the unfortunate, the adventurous, the pioneer settler, the artisan, the businessman, eager to begin life anew, to gain wealth, or to enjoy the fruits of liberty in a youthful Republic, provided the work force and the domestic markets for agriculture, industry, and commerce. The pattern of the national economy varied all the way from the pursuits of frontier life, to those of the farm, the cottage craftsman, the laborer and factory worker, the merchant, banker, businessman. Time and place were ripe for the development of engineering.

In 1852 the United States and the nations of the Western World were beginning to feel the strong impact of the Industrial Revolution. A way of life which had been based largely on agricultural and commercial influences was yielding to the pressures of change that an industrial civilization was to exert. Life on a farm was relatively self-sufficient. Food, clothing, shelter, fuel were local products. Little need be purchased. Tools and utensils were few, simple, and not difficult to make. Man himself and his domestic animals, with some aid from steam and water power, provided the energy necessary to make a living. Handicrafts prevailed, except in a few instances such as textile mills, sawmills, gristmills, and iron foundries and forges. The great bulk of machinery, which eased manual labor, increased productivity, but required capital, was yet to come. Except for the telegraph, electricity had no practical significance. A few miles of railroad had been built, but the horse and the stagecoach and covered wagon bore the bulk of land transportation. The internal-combustion engine, which was to put a nation on wheels and provide thousands of small power units, was yet to be introduced. McCormick had invented the reaper, Howe the sewing machine, Corliss the economical factory engine, Francis the improved water wheel, but development of these devices was yet to come. The Bessemer and open-hearth processes of steel manufacture were unknown. The only materials available, with few exceptions, were those man had used for centuries. Goodyear had vulcanized rubber but the rubber industry was a mere infant. Hall was yet to make aluminum a metal of commercial usefulness. Whitney and North had demonstrated the economic possibilities of interchangeable-parts manufacture, but mass production awaited the development of precision manufacture, gages, the widespread availability of machinery and power, the assembly line, and mass markets and mass marketing. These developments, and many more, are contributions science and engineering were to make to the century's progress.

Up to the middle of the nineteenth century, engineering had received little stimulus from science. Engineering itself dealt largely with construction—roads, canals,

earthworks, buildings, aqueducts, bridges, fortifications, docks, hydraulic structures, excavations, ships. Land surveying, navigation, mechanics, hydraulics demanded the ability to use only elementary mathematics. The Institution of Civil Engineers had been organized in London in 1828. But even when the locomotive builder Stephenson sought admission to the society, so little were engines, machine tools, and machinery regarded as belonging to the field of engineering that he was compelled to form The Institution of Mechanical Engineers in 1847 to provide opportunities for men in these fields to meet for the discussion of their engineering problems. And it was not until 1880 that The American Society of Mechanical Engineers was to be organized.

Men had been using steam engines for a hundred years. Joseph Black had discovered the latent heat of steam in Watt's day. Count Rumford and Sir Henry Davy had inquired into the relation of heat and mechanical work before 1800 and Carnot had written on the motive power of heat in 1824, but in 1852 Foule was still struggling to obtain an accurate figure for the mechanical equivalent of heat and Lord Kelvin had just stated the Second Law of Thermodynamics. Joseph Henry was at work on electromagnetism 20 years before 1852 and Thomas Davenport had built an electric motor shortly thereafter, but it was not until more than another quarter century had rolled by that Edison's first central station was to supply New York City with electricity. In the Centennial we celebrate, engineering grew more dependent on science and out of that union came the great advances that have been made in the field of power.

It had been a policy of the British government to look upon their colonies as a source of raw materials and a market for manufactured goods, and hence the development of manufactures had been denied the American colonists. With the winning of their independence the United States exercised the native talents of their citizens in developing all crafts and industries necessary for the economy of the country, and by 1852 they were well along the road of industrial supremacy they have since attained. Need, opportunity, and resources in materials and ingenuity were great and the social climate was favorable. The Patent Office and The Franklin Institute were powerful factors of incentive and encouragement to the growing industries of the nation. In the five years ending 1850 the number of patents issued was 3517, and in the next five years it was 6143. By 1831 loss of life and property resulting from explosions of boilers on steamboats and on land had become so serious a menace to the future development of steam power that The Franklin Institute, using the first money appropriated by Congress for research, conducted a series of tests and studies relating to the subject and laid the foundations for the uniform rules for the construction of steam boilers and allowable working pressures issued as the first ASME Boiler Code in 1914. This is but one of the many examples that could be given to show how during the past century, engineers have tried to cope with the evil consequences that sometimes accompany the material progress for which they are responsible.

The desire for educated leaders of church and state, which prompted the founding of the colonial universities and has persisted to this day, was natural in a people with traditions of self-government. By 1852 schools were to be found wherever there were settlements. With a strong heritage of literature and culture common with that of England, New England produced writers, philosophers, artists, historians, and scientists to a remarkable degree. It was natural that there should accompany this interest in education and culture, a concern for agricultural science, geology, biology, and chemistry and that these subjects should not only be studied in the colleges, but should result in surveys of natural resources and be brought to the people in lyceums and lectures delivered by itinerant scholars. The founding of the United States Military Academy at West Point in 1802 provided a natural setting for the origins of engineering education and by 1852, nonmilitary schools, notably Rensselaer Polytechnic Institute, were offering courses in engineering, and the older universities, such as Harvard and Yale, were teaching science and engineering. But it was not until the passage of the Morrill Act in 1862, establishing the land-grant colleges, that engineering education began an era of expansion and proliferation of engineering colleges and curricula. From these institutions thousands of young men, who had to possess a high level of intelligence to cope with the rigors of their scientific studies, swarmed into American industry at a time when not only sound technical knowledge was in demand, but a sense of social justice was needed to meet the economic and human problems raised by an industrial civilization in full flower. Such contributions to a century of progress reflect credit on the engineers who made them.

Over the clear skies of optimism, confidence, and faith in its destiny that smiled on the nation in 1852, a cloud was beginning to form. The great test of liberty and union was less than a decade away. Harriet Beecher Stowe's slavery story appeared in book form in 1852. The great war was to retard industrial development until it could be given a new burst of forward speed noted at the Centennial Exhibition of 1876. But the spirit of freedom was to be revitalized. In that revitalization humble people were to enjoy the fruits of freedom in shorter hours of work, in transferring the major burdens of manual labor to machines, in the enjoyment of a higher standard of living, better health, and more recreation. Toward this progress engineering made its greatest contribution. And if today freedom is in despair or in hiding in some parts of the world, may it not be that engineering will help to restore it to the people? Transplanted into a new world where it grew strong, shall it not now share this strength in the places of its origin and in all parts of the world where it has never been and still is but a hope? And will not engineering which increases the productivity of human labor and raises the material standards of living wherever it is practiced for the benefit of the people, assist in this great work? These are the questions that the Convocation at the Centennial of Engineering should answer.

OPERATING EXPERIENCES *With Cyclone-Fired* STEAM GENERATORS

By V. L. STONE[1] and I. L. WADE[2]

FIVE years of cyclone-furnace operation have provided the experience with which to evaluate the merits of this new method of burning coal. Knowledge has been gained on ten different boiler installations by the Commonwealth Edison Company and the Public Service Company of Northern Illinois. As with most new developments not all of the original hopes as yet have been fully realized.

INTRODUCTION

One of the important items involved in the production of electricity in Illinois is coal. Outside of the relatively minor amounts of water power and other fuels, such as gas and oil, coal is by far the principal fuel item. Fortunately, Illinois has tremendous bituminous-coal resources and is the fourth largest producer among the states, the normal yearly tonnage being about 65,000,000 tons or approximately 11 per cent of the coal production of the United States. The Edison Companies consume approximately 14 per cent of the Illinois output.

The most economical source of coal for the Edison Group of Companies is known as Central Illinois coal which comes from an area approximately 210 miles from Chicago. The majority of the coal is transported by combination of rail and water-borne barges. While the distance from the Chicago area results in relatively low-cost transportation, this particular coal has certain qualities which decidedly affect the equipment used for burning it. It is believed that all of the boiler manufacturers consider Central Illinois coal as presenting the worst problems they have to meet from the standpoint of supplying equipment for its consumption. Briefly, this is a high-ash-content low ash-fusion temperature coal, typical analyses of which are shown in Table 1.

It is this over-all consideration that led the Edison Group to continue a search for better fuel-burning equipment, and, in conjunction with co-operative research with the manufacturers, led to the experimental work on the cyclone type of furnace.

Five years ago a paper was presented by Messrs. Grunert, Skog, and Wilcoxson,[3] which described experimental work conducted by The Babcock & Wilcox Company and the Commonwealth Edison Company on a pilot plant and upon a development unit installed at the Calumet Station of the Commonwealth Edison Company. Since that time further experiments have been conducted at Calumet Station, and a number of other boilers equipped with cyclone furnaces have been installed and operated.

Experiences related and data presented in this paper are based upon the operation of 10 cyclone-fired installations which are now in service (Table 2).

TABLE 1 TYPICAL ANALYSES OF CENTRAL ILLINOIS COAL AND ASH

Proximate, per cent:	
Moisture	14.0
Volatile matter	34.0
Fixed carbon	37.8
Ash	14.2
* Total	100.0
Ultimate, moisture and ash-free, per cent:	
Sulphur	6.48
Hydrogen	5.43
Carbon	77.16
Nitrogen	1.39
Oxygen	9.54
Chloride as NaCl, per cent on dry basis	0.37
Btu per lb, as fired	10050
Ash, per cent by weight:	
Silica, SiO_2	40.43
Alumina, Al_2O_3	19.98
Iron oxide, Fe_2O_3	25.11
Calcium oxide, CaO	5.08
Magnesium oxide, MgO	1.09
Sulphuric anhydride, SO_3	5.19
Phosphorus pentoxide, P_2O_5	0.01
Alkalies, sodium and potassium oxides, Na_2O and K_2O	3.04
Chloride, Cl	0.07
Total	100.00
Water-soluble constituents in ash, per cent by weight:	
Ferrous sulphate, $FeSO_4$	0.30
Sodium sulphate, Na_2SO_4	1.37
Calcium sulphate, $CaSO_4$	4.87
Magnesium sulphate, $MgSO_4$	1.43
Sodium chloride, NaCl	0.05
Total	8.02
Coal ash-fusing temperatures (reducing atmosphere):	
Initial deformation, deg F	1980
Softening, deg F	2025
Fluid, deg F	2340

In the paper presented in 1946,[3] the authors reached certain tentative conclusions as to the advantages of cyclone furnaces, and it is the intention that this paper serve as a sequel to the earlier paper in determining the accuracy of those conclusions and in re-evaluating cyclone furnaces up to the present time.

Multiple-cyclone operation has entailed some complexity of design, particularly in auxiliary equipment, and in operating procedures not encountered in the single cyclone unit. Higher steam temperature and the bin system of firing also have introduced problems not encountered in the Calumet unit. With such an entirely new method of firing, difficulties were expected. Such was the case in the early development with all other methods of firing coal.

A brief description of each of the boiler units will be followed by a discussion of the various aspects of their operation.

A companion paper by Messrs. Schroeder and Strasser[4] covers the features of power-station design which are charac-

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[3] "The Horizontal Cyclone Burner," by A. E. Grunert, L. Skog, and L. S. Wilcoxson, Trans. ASME, vol. 69, 1947, pp. 613–627.

Contributed by the Fuels and Power Divisions and presented at the Annual Meeting, Atlantic City, N. J., November 25–30, 1951, of The American Society of Mechanical Engineers.

[4] "Station Design With Cyclone-Fired Steam Generators," by H. C. Schroeder and R. J. Strasser, Trans. ASME, vol. 74, 1952, pp. 573–578.

TABLE 2 CYCLONE-FIRED INSTALLATIONS

Station	Boiler	Service date	No. of cyclones per boiler	Firing method	Boiler capacity, lb per hr	Steam pressure at SH out, psi	Steam temperature at SH out, deg F
Calumet	20-A	Sept. 1944	1	Direct	180000	350	650
Waukegan	13	Jan. 1949	2	Bin	300000	675	750
Fisk	18-1	Apr. 1949	4	Direct	750000	1325	935
Fisk	18-2	June 1949	4	Direct	750000	1325	935
Joliet	3	Jan. 1950	3	Bin	600000	1325	1010
Joliet	4	Jan. 1950	3	Bin	600000	1325	1010
Ridgeland	2-1	Oct. 1950	4	Bin	730000	1900	1050
Ridgeland	2-2	Oct. 1950	4	Bin	730000	1900	1050
Ridgeland	1-2	Mar. 1951	4	Bin	730000	1900	1050
Ridgeland	1-1	May 1951	4	Bin	730000	1900	1050

teristic of cyclone-furnace installations. In that paper the authors describe the various cyclone-boiler installations and show the savings in construction costs made possible by a reduction in building requirements and the use of smaller precipitators. These items are purposely omitted from this paper but should not be lost sight of in any evaluation of cyclone furnaces.

DESCRIPTION OF UNITS

The Calumet installation is a single cyclone unit with typical boiler cross section of narrow width, designed especially for proving the cyclone under actual operating conditions. It is direct-fired, has no economizer or dust collector, has a two-section pendant superheater with attemperator control and a desuperheater for reducing steam temperature from 900 F to station condition of 650 F. The cyclone furnace has a nominal diameter of 8 ft and is 11 ft long. This same size of cyclone has been used in subsequent installations.

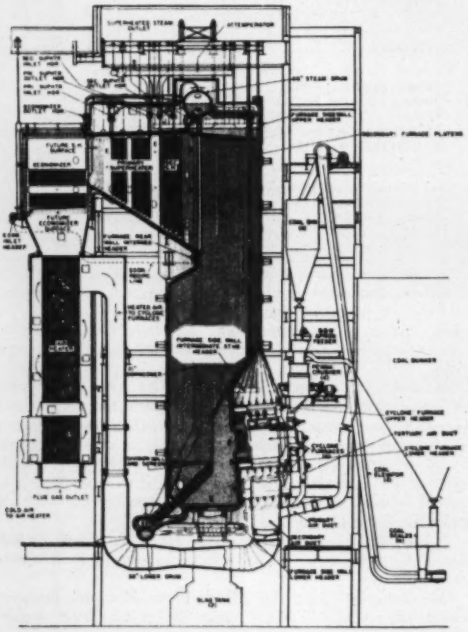

FIG. 1 UNIT NO. 18, FISK STATION, SECTIONAL SIDE VIEW OF BOILER UNIT

The first multiple-cyclone-fired boiler to go into service was at Waukegan Station. The desire to determine further the value of cyclone firing for reducing stack dust, and the necessity of replacing certain boiler auxiliaries on a 1929 pulverized-coal-fired boiler prompted the rebuilding of one boiler with the installation of two cyclone furnaces. This installation, although not accomplishing all that was expected, has reduced greatly the ash discharge from the stack. It has been in regular and continuous service since January, 1949, with only the normal amount of outage and the usual difficulties encountered with any large boiler installation. It also is equipped for burning natural gas and heavy oils.

The next installation and the first boilers of this list to be originally designed for multiple cyclone firing are the two units at Fisk Station.

The Fisk Station Unit 18 steam generators are shown in Fig. 1. Each boiler has four cyclone furnaces tipped at 5 deg from horizontal, bolted to the front wall of the primary furnace, suspended by their respective riser tubes, supplied with boiler water under natural circulation, and interspaced across the width of the furnace at two levels. The two left-hand cyclones are arranged for clockwise rotation of the gases and the two right-hand cyclones have counterclockwise rotation.

Coal feeds by gravity from the 1000-ton boiler bunkers through automatic coal scales to Redler conveyers and is then elevated to 30-ton head hoppers, four per boiler. This arrangement was necessary because of lack of headroom in the existing boilerhouse. The Redler conveyers are actuated by level controls in the head hoppers. Coal then feeds from these hoppers through variable-speed apron feeders and hammermill crushers to the respective cyclones. Optimum coal size is shown in Table 3.

TABLE 3 OPTIMUM COAL SIZE FOR CYCLONE FIRING

Screen mesh number	Per cent passing through
4	95
8	85
14	70
28	50
48	30
100	20
200	10

Combustion air is supplied by two 1775-rpm, constant-speed, motor-driven, centrifugal compressors with inlet-vane control and silencers on the inlets. Shutoff valves in the discharge of each fan provide for fan outage. Air at 60 in. of water maximum is delivered through the five-pass tubular air heater to a common duct with branches to each of the four

cyclone furnaces. Each branch contains an air-metering Venturi and a valve which is closed when the cyclone is out of service. Each of the cyclone ducts is again branched to provide primary air at the feeder, tertiary air at the front center of the cyclone, and secondary air through three ports into the periphery of the cyclone furnace. Control or velocity dampers are located in each of these five air ports to each cyclone.

Molten slag flows from each of the cyclones through slot taps into the primary furnace. Slag from the cyclones together with that drained from wet surfaces in the primary and secondary furnaces taps continuously through the two floor openings into quenching tanks below. The granular slag is removed intermittently from the tanks and transported by hydrojet sluicing to outdoor pits. Capacities of the slag tanks, two per boiler, are about 68,000 lb of slag each.

Gaseous products of combustion leave the cyclones through 42-in. re-entrant throats, tend to impact on the wet primary-furnace floor by action of the division wall, pass through the wet-surfaced screen into the secondary furnace, and then pass through superheater, economizer, air heater, mechanical dust collector, and induced-draft fans to the stack.

Coal fuel only has been burned in these furnaces although provision is made for possible future installation of oil burners.

The Joliet units have three cyclones per boiler with bin system of firing coal as well as oil and natural gas. There are no dust collectors. Boiler design is similar to that at Fisk. A boiler side elevation is shown in Fig. 2.

The Ridgeland units have four cyclones per boiler, bin-system firing, and electrostatic dust collectors. Coal, natural gas, or a combination of these can be burned in the cyclones. Boiler design is similar to that at Fisk and Joliet Stations with modifications for higher steam pressure and temperature. A boiler side elevation is shown in Fig. 3.

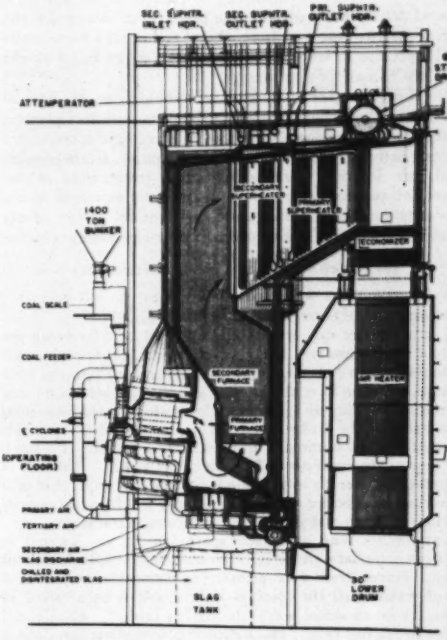

FIG. 3 UNITS NOS. 1 AND 2, RIDGELAND STATION, SECTIONAL SIDE VIEW OF BOILER UNIT

METHOD OF CONTROL

Basically, the control system for these boilers is unchanged from the Calumet installation except for refinements to adapt to multiple-cyclone operation. Combustion requirements for each cyclone are necessarily treated individually. Coal-feed rate is controlled by variable speed of the apron feeder, a tachometer serving as a metering guide. Air quantity is a function of forced-draft duct pressure and velocity damper openings. Duct pressure, common to all cyclones, is adjusted by the inlet vanes of the forced-draft fans and automatically controlled by a duct pressure regulator. The forced-draft fans provide a pressure of about 30 in. of water at low cyclone rating and about 40 in. at high cyclone rating. Lower pressure provides poor cyclonic action in the furnace and increases dust loading. Higher pressure tends to increase burner-scroll wear, increases fan power beyond justifiable needs, does not reduce dust loading appreciably, and tends to cause coal-feed interruptions. The three secondary-air dampers are operated in tandem by remote automatic control. Manual bias adjustments of the individual dampers are provided, but after initial adjustment for a type of coal are not changed. Probably somewhat better combustion conditions, as affecting dust loading, carbon loss to fly ash, and maintenance of a uniform slag coat in the cyclone, could be obtained by individual readjustments, but results are less easily observed in multiple-cyclone installations, and the required attention would be prohibitive. The primary-air damper is controlled remotely, but, after a cyclone is put in service, the damper is seldom readjusted. The tertiary-air damper is adjusted manually and seldom changed with a given fuel.

To date, efforts to sample flue gases from individual cyclones on boilers with more than two cyclones have been unsuccessful owing to contamination from adjacent cyclones, and because

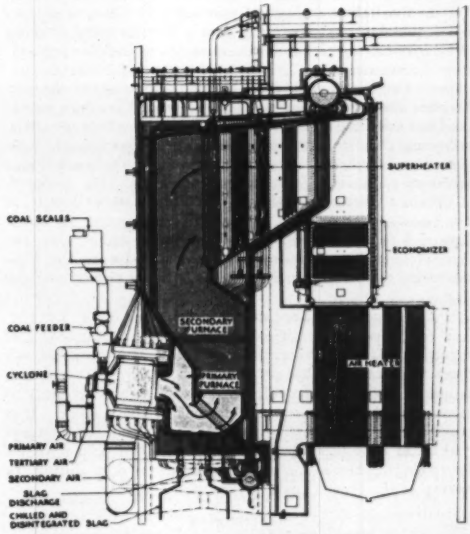

FIG. 2 UNIT NO. 5, JOLIET STATION, SECTIONAL SIDE VIEW OF BOILER UNIT

of rapid deterioration of sampling tubes. For this reason the general practice is to supply equal fuel and equal air quantities to all cyclones in service and to use the boiler meter as the guide for fuel-air proportioning.

Fuel feed, whether coal, gas, or combination, air flow as adjusted by the secondary velocity dampers, and duct pressure as adjusted by the forced-draft-fan inlet vanes are controlled automatically by impulses from the master steam-pressure regulator. In some installations, steam temperature is also controlled automatically. Furnace draft, as measured in the secondary furnace, is maintained constant by action of the induced-draft-fan inlet vanes controlled by a pressure regulator.

OPERATING PROCEDURES AND CHARACTERISTICS

A few comments will tend to show the general operating characteristics of the cyclone firing method.

A large boiler can be brought up from cold by firing one cyclone continuously. Early practice was to fire alternate cyclones so as to equalize temperature rise throughout the wide furnace. Studies have shown that any one cyclone can be used for the entire bring-up. Other cyclones are warmed by natural circulation of the boiler water. Continuous firing is possible inasmuch as the minimum firing rate for a cyclone is a small per cent of the total normal rating of the boiler. The rate of bringing a boiler up to pressure is no different from that of a pulverized-coal boiler and is limited only by the usual considerations of drum and superheater-tube temperatures.

Gas torches with automatic spark igniters are located in the front secondary-air ports. Natural gas is supplied at about 4 psi. Forced-draft duct pressure is maintained at about 5 in. of water until the torch is lighted and is then raised to about 15 in. of water while the coal is ignited. Coal is fed at $^1/_8$ to $^1/_3$ full rate. The light-off is immediate for Illinois coal and, with the low percentage of fines, there is no tendency to puff, regardless of whether the furnace is hot or cold. After coal ignition is stabilized, duct pressure is raised to about 25 in. of water and use of the torches is discontinued. Removable oil torches also are provided for ignition in the event of gas-supply interruption. When lighting a cyclone with other cyclones already in service, duct pressure to that cyclone is throttled by means of the sealing valve in the cyclone duct.

The cyclone-furnace slag tap is sometimes fouled with coke and viscous slag during the bring-up. After high rating is established the tap clears itself.

Practical load range of any cyclone is about 25 to 133 per cent; however, undesirable combustion conditions generally prevail below about 40 per cent rating.

Practical load range of a boiler is about 50 to 110 per cent of rated capacity. This lower limit is established primarily by inability to maintain steam temperature. Slag fluidity at the primary-furnace tap also becomes more difficult to maintain although boilers have been operated at as low as 20 per cent of rated capacity for extended periods. Frequently, boilers are operated at rated capacity with only three of the four cyclones in service.

One of the first difficulties observed was the rapid fluctuation of furnace pressure of about 2 in. of water which made it difficult to open observation doors and necessitated carrying a higher furnace draft with the attendant higher air leakage. After considerable experimentation it was found that introducing approximately 50 per cent of the primary air above the feeder apron tended to blow the coal off the feeder at a more steady rate and at present this seems to have corrected the difficulty.

Protection against, or warning of loss of ignition is an important consideration in cyclone firing in that interruptions in coal flow may occur and reignition from other burners is impossible or undependable at least. Coal-flow interruptions have been frequent at Ridgeland where an inadequate coal-sealing head is provided. Vibrators are installed at the bunker outlets and may be operated manually or automatically. Low-level alarms have been provided above the coal scales, in the hopper below the scales, and on the feeder belt. In addition, a photoelectric cell or "flame eye" is focused through the front center observation window of each cyclone into the flame. None of the alarm devices have been completely reliable; however, the devices collectively seem to provide adequate protection. The photoelectric cell has rarely failed to function but does give false alarms. A suitable time-delay feature was necessary to minimize actuation when a dense coal stream in the burner obstructs vision. Frequent cleaning of the observation windows is necessary.

EXPERIENCE WITH FUELS OTHER THAN CENTRAL ILLINOIS COAL

Natural gas and a variety of fuel oils have been burned successfully in a number of the cyclone furnaces. Gas is admitted to the cyclone furnace through three flat open-ended burner pipes located in the secondary-air ports. This fuel has been burned alone or in combination with coal to rated capacity of the furnace for long periods with little or no difficulty. The slag coat in the cyclone thins with continued use of gas but this has resulted in no appreciable damage to the surfaces. When burning gas only, unheated forced-draft air is supplied to the coal inlet of the feeder to prevent firing of pocketed coal by backflow of heated air. A tendency of the burner scroll and cone blocks to overheat has been alleviated by supplying a small amount of air through the tertiary port.

Fuel oil of various grades has been burned successfully in combination with coal in amounts of 50 per cent of the total fuel fired. Full rated load has been carried for a period of 2 days using oil only without difficulty.

The single-cyclone furnace unit at Calumet Station occasionally has been used to test-fire coals of various ranks. Each test involved the burning of approximately 500 tons of coal and required several operating days. Various rates of firing and various firing techniques were tried to establish performance characteristics.

Coals ranging in rank from North Dakota lignite through Virginia Pocahontas, and coals from France have been tested. Coal and ash analyses are shown in Table 4. All of the coals, excepting that from Pennsylvania Top Freeport seam, were burned satisfactorily. However, for some of the coals it was necessary to deviate from normal operation. For example, to obtain adequate predrying of the North Dakota lignite, it was necessary to increase primary-air temperature to 650 F compared to 450 F normally available. The failure with the Pennsylvania Top Freeport seam coal was due to the high ash-fusing temperature and the highly viscous character of the slag.

It will be noted that one of the French coals has an ash content of 37 per cent. This is the highest-ash-content coal burned to date in the cyclone furnace. This coal has ash characteristics somewhat similar to the Top Freeport coal and, in order to obtain acceptable performance, it was necessary to increase air temperature to the cyclone to about 900 F. It is possible that acceptable performance with the Top Freeport coal could have been obtained if facilities had been available for raising preheated air temperature as was done during the testing of the French coals.

MAINTENANCE

An accurate cost of over-all maintenance requirements for cyclone-fired boilers has not yet been obtainable because of

TABLE 4 ANALYSES OF COALS TESTED IN CALUMET CYCLONE FURNACE

Coal source													
Country	U. S.		U. S.		U. S.		U. S.		U. S. Ohio		U. S. West Va.		U. S. Penna.
State	N. Dakota		So. Ill.		Illinois		West Ky.		Tuscarawas		Marion		Allegheny
County	Ward				Jefferson		Union		Middle		Fairmont		Freeport
Seam	Velva				No. 6		No. 9		Kittanning		Top		Freeport
Proximate analysis, per cent													
Moisture	38.0		11		10.8		5.0		10.5		4.0		3.9
Volatile matter, dry	47.0		33.0		33.3		36.4		39.0		37.0		34.5
Fixed carbon, dry	43.5		49.0		51.5		50.6		47.0		52.0		51.3
Ash, dry	9.5		18.0		15.2		13.0		14.0		11.0		14.2
Sulphur, per cent	0.7				1.8		4.5		4.8		2.5		1.5
Heating value, Btu per lb	11000		11520		12060		12700		12350		13300		12920
Ash-fusing temperatures:	Red[a]	Ox[b]	Red	Ox	Red	Ox	Red	Ox	Red	Ox	Red	Ox	Red	Ox
Initial deform, deg F	2270	2340	2070	2160	2090	2360	1930	2340	2000	2370	2050	2340	2340	2520
Softening temp, deg F	2360	2400	2110	2210	2200	2410	2050	2500	2050	2500	2130	2430	2540	2600
Fluid temp, deg F	2500	2560	2470	2550	2520	2670	2440	2650	2450	2600	2650	2760	2780	2800
Slag temperature for 250 poise vis, deg F					2370		2130		1900		2270		2750	

Coal source									
Country	U. S.		France		France		France		
State	West Va.		Lorraine		Lorraine		Lorraine		
County	Pocahontas		Mines		Mines		Mines		
Seam	No. 3								
Proximate analysis, per cent									
Moisture	2.9		7.9		7.1		10.9		
Volatile matter, dry	25.7		36.4		30.0		23.2		
Fixed carbon, dry	66.2		55.4		43.3		39.8		
Ash, dry	8.1		8.2		26.7		37.0		
Sulphur, per cent	0.4		0.8		1.2		1.1		
Heating value, Btu per lb	14180		13250		10230		8580		
Ash-fusing temperatures:	Red	Ox	Red	Ox	Red	Ox	Red	Ox	
Initial deform, deg F	2110	2360	2190	2300	2170	2310	2190	2300	
Softening temp, deg F	2280	2440	2310	2500	2340	2530	2340	2520	
Fluid temp, deg F	2640	2710	2670	2820	2780	2830	2800	2830	
Slag temperature for 250 poise vis, deg F	2580		2610		2620		2760		

[a] Red—reducing atmosphere.
[b] Ox—oxidizing.

developmental revisions and excessive superheater fouling. It is expected that the total maintenance of cyclone boilers can be reduced to a satisfactory level when the problem of superheater fouling has been solved.

In the bin system of coal preparation at Joliet Station, maintenance cost of wear parts in the crushers is approximately 0.8 cent per ton of coal. Life of the crusher hammers is approximately 120,000 tons of coal, and crusher bars 240,000 tons of coal.

In the direct-fired system at Fisk Station maintenance costs including Redler conveyers, feeders, crushers, burners, and other parts, comprising the coal equipment, are approximately 7 cents per ton of coal. Life of a set of crusher hammers is about 85,000 tons, and life of crusher bars is about 125,000 tons.

The foregoing maintenance costs for cyclone firing equipment may be subject to some upward revision inasmuch as longer usage will entail more extensive replacement of parts.

Breakage of links in the Redler conveyers was excessive at Fisk, averaging about 1.5 interruptions per boiler (four conveyers) per month. This has been practically eliminated by replacing with heavier and higher-tensile-strength links. Only one breakage has occurred in 7 months. There is no Redler conveyer in the bin-system installations.

Cyclone wear occurs mainly in the inlet scroll and on the cone surface. Life of alloy cast-iron or alloy cast-steel scroll liners has been determined as about 30,000 tons in the more severe wear regions. Six tungsten-carbide-faced liners have been in service for over a year and have handled some 55,000 tons of coal to date. Burners are now designed with covered access slots through which the shorter-lived scroll liners can be replaced without entailing boiler outage.

FIG. 4 CYCLONE FURNACE, JOLIET STATION, VIEW OF DETERIORATED BURNER SCROLL PLATES AND CONE CLAMP BLOCKS

The Fisk cyclones originally had wear blocks clamped to the circular tubes in the burner cone. Approximately 30 per cent of these blocks have failed and have been replaced with flat studs welded to the tubes. Failures resulted from overheating and occurred at the top and bottom of the circle owing to poor contact with the tubes. The Joliet cyclones were installed with flat studs in the lower area. Some clamp blocks have failed and have been replaced with studs. Fig. 4 shows the extended stud area and deterioration of clamp blocks. The Ridgeland cyclones were installed with flat studs in these local areas and no failures have occurred. Eventually these studs will require rebuilding.

The Calumet cyclone was rearranged in April, 1951, by moving the scroll assembly closer to the furnace cylinder, thereby eliminating the cone section. Good operating results have been obtained to date in this arrangement, and it is expected that future cyclones will be of similar design.

Building up of the studs by welding in the bare-stud quadrant at the secondary-air inlet is necessary, but this is a minor item. Studs on the cyclone-wall surfaces shortened, particularly at the tube bends near the secondary-air inlet and around the discharge throat. It has been necessary to rebuild studs in these local areas. Stud deterioration is caused mainly by burning rather than wear and has been much more severe in the multiple-cyclone units than in the Calumet cyclone.

Three reasons might be ascribed for this difference. The Calumet cyclone has more desirable tube spacing in the bends, the single cyclone lends itself to more rigid control of combustion conditions, and frequent high loading of the multiple cyclones has occurred.

Tube failures on all cyclones to date have been as follows:

1 Two tubes have cracked circumferentially in the Calumet cyclone, apparently from strain under thermal changes.

2 A cyclone-furnace tube leak at Fisk appeared to have resulted from unintentional cutting with an acetylene torch.

3 At Waukegan a cyclone furnace tube was eroded through by coal in the bare-stud quadrant.

4 A primary-furnace floor tube was eroded by slag during a furnace leak.

Three furnace slag leaks have occurred. Two were in the primary-furnace floor where the original sealing was not adequate and the third leak occurred at the seal between primary-furnace floor and side wall.

No tube failures have occurred in any of the cyclone-fired units that might be attributed to circulation or boiler-water conditions. In general, boiler-water conditions are maintained as follows: 650 ppm maximum total solids, 10.5 to 11.0 ph, 5 ppm maximum silica (2 ppm at Joliet and Ridgeland), 5 to 20 ppm residual phosphate, and 5 to 10 ppm residual sulphite (2 to 5 ppm at Ridgeland).

The primary-furnace slag-tap cooling coils have required considerable maintenance. Without question, cyclone firing subjects these cooling coils and the slag-tank hoods to rapid deterioration. Higher slag recovery entails more material handling, and a more corrosive atmosphere seems to prevail. Owing to the pulsating furnace draft, a continual breathing of furnace gases through the taphole occurs. Aside from failures due to cooling-water interruptions, life of studded mild-steel coils using cold water was less than 6 months. Owing to the cost of supplying condensate to these coils at Fisk and Ridgeland, other means of correcting the difficulty were tried. Stainless-clad and all-stainless coils were used but failure by cracking occurred. At Joliet where 75 F to 95 F condensate is used for cooling, no particular difficulty has been encountered to date, and the cooling-water supply at Fisk and Ridgeland has now been changed to condensate. Satisfactory life of the coils seems to be promised.

DUST EMISSION

Dust emission from the Calumet boiler was reported as 0.659 grain per standard cu ft (32 F and 1 atm) under normal operating conditions. This was further increased by soot-blowing about $2^1/_2$ per cent to account for about 10 per cent of the total ash in the coal. No attempt was made to evaluate relative quantities of ash collected wet in the cyclone furnace and in the primary furnace.

The Fisk boilers originally had a relatively less extensive wet-slag screen at the primary furnace. Platens on 18-in. centers comprising 100 tubes constituted the Fisk screen whereas Calumet had two tiers of screen platens both on $13^1/_2$-in. centers with the upper tier being staggered in relation to the lower. Tests at Fisk indicated furnace dust emission of about 1.2 grains per standard cu ft with 22 per cent excess air. Guarantee equivalent was 0.719 grain.

After 9 months of operation, the screen-tube bank of one Fisk boiler was revised to provide 188 tubes on 9-in. side centers. This reduced the furnace-exit dust loading to 0.56 grain which was comfortably within the guarantee. This is equivalent to approximately 7 per cent of the ash in the coal leaving the boiler as fly ash. Since then, similar screen revisions have been made in the other Fisk boilers, and one Joliet boiler, and in all subsequent boiler installations this revision is being incorporated.

Centrifugal-type dust collectors installed at Fisk have to date proved unsatisfactory. Over-all collection efficiency has been about 48 per cent. With higher percentage of fines from cyclone firing, the stack product, although low in mass, has high light-reflection characteristics and appears dense. The electrostatic precipitators at Ridgeland have provided a low stack discharge of about 0.095 grain. Dust loadings and collector performance data are shown in Table 5.

TABLE 5 DUST LOADING AND COLLECTOR PERFORMANCE

Station unit	Calumet 20-A	Fisk 18	Joliet 5	Ridgeland 2
Furnace discharge, guarantee equivalent grains per cu ft at 32 F, 22 per cent exc. air	...	0.719	0.719	0.719
Furnace discharge, test grains per cu ft at 32 F, 22 per cent exc. air	0.659	0.561	0.665	0.677
Type of collector	None	Mechanical	None	Electrostatic
Collector efficiency, guarantee or expected, per cent	...	68	...	80
Collector efficiency, test, per cent	...	47.9	...	86
Stack discharge, grains per cu ft at 32 F, 22 per cent exc air	0.659	0.29	0.665	0.095

The carbon content of the cyclone-fired fly ash ranges from 1.5 to 10 per cent under normal firing conditions and as high as 15 to 20 per cent with poor firing conditions. Color of the ash is distinctly dark.

EVAPORATIVE EFFICIENCY TESTS

Results of evaporation efficiency tests and related data are shown in Table 6. Only one test was made at Fisk. For brevity four typical tests of the nine tests performed at Joliet are reported and similarly only four tests of 16 performed at Ridgeland are reported.

Evaporative efficiencies at rated loads are about 87 to 88 per cent. In the Ridgeland tests evaporative efficiencies and un-

TABLE 6 EVAPORATION EFFICIENCY TESTS

Station	Fisk	Joliet				Ridgeland			
Boiler	18-2	4	4	4	4	2-2	2-2	2-2	2-2
Test no.	...	7	3	1	2	7	3	14	11
Duration, hr	72	4	4	4	4	6	6	6	4
No. of cyclones in service	72	2	3	3	3	2	4	4	4
Kind of coal	Various	Kincaid, Mines 8 and 9				Kincaid, Mine 8			
Coal as fired:									
Moisture, per cent	15.41	15.27	14.70	14.90	14.42	14.30	14.36	13.74	13.67
Ash, per cent	16.55	14.72	14.50	15.79	15.45	14.36	15.41	15.62	14.78
Btu per lb	9452	9812	9946	9752	9799	9972	9805	9850	9978
Ultimate coal analysis:									
Carbon	78.26		76.51				77.48		
Hydrogen	5.59		5.49				5.36		
Sulphur	7.17		6.44				6.89		
Nitrogen	1.54		1.26				1.53		
Oxygen	7.44		10.30				8.74		
Coal burned, lb per hr	91896	36420	53280	73980	78880	43066	61666	85533	93600
Water evaporated, lb per hr	744810	291859	434851	590775	627258	357537	500700	681170	751946
Steam pressure, psig	1281	1301.7	1311.4	1323.7	1324.2	1845	1903.5	1896	1893
Temperatures, deg F:									
Water to boiler	451.0	451.8	451.6	454.5	455.4	401	452.3	459.9	455
Steam from superheater	932.7	988.9	1010.8	1009.8	1012.0	931	1046	1050.2	1049
Steam from pri. SH, LH	791	797.2	847.4	885.5	914.8	738.7	819	877.1	904.8
Steam from pri. SH, RH	798	783.9	841.1	891.2	917.2	769.1	820.4	877.9	901.7
Steam from sec. SH, LH	935	983.7	1002.7	1001.6	1006.8	898.9	1055	1055.3	1046.4
Steam from sec. SH, RH	932	979.1	1003.2	999.8	1001.3	972.5	1035.8	1052.3	1054.8
Air to forced-draft fans	84	63.2	76.7	71.2	72.4	62	63	60.3	73.3
Air to air heater	114	87.9	96.3	97.3	96.7	98	92.4	84.1	100.4
Air from air heater	522	507.2	533.1	593.8	590.2	495.5	537.2	572.9	598
Flue gas to economizer	865	684.3	744.8	861.3	866.8	678.5	730.4	793.4	837.7
Flue gas to air heater	642	588.2	629.9	705.2	707.4	524.5	604.6	662.8	697.7
Flue gas from air heater	341–318	290.4	306.2	338.0	336.3	254	278	301	321
Air pressures, in. water:									
To air heater	46.3	37.7	42.0	49.8	51.5	43.5	40	46.5	51.8
Secondary air	34–36	35.2	38.2	41.2	42.0	37.4	34.0	33.8	36.2
Primary air	30	29.8	29.9	35.4	36.2	...	...	...	...
Drafts, in. water:									
Furnace	1.4	1.11	1.20	1.00	...	1.15	1.26	1.11	1.46
Superheater inlet	0.78	...	...	...	...	...	...	...	...
Economizer inlet	1.73	1.23	1.56	2.13	2.25	1.33	1.78	1.99	2.64
Air-heater inlet	2.50	1.84	2.56	4.15	4.29	1.95	2.79	3.78	4.83
Dust-collector inlet	6.60	...	...	...	...	3.8	5.68	9.17	11.31
Dust-collector outlet	8.90	...	...	...	...	...	...	...	11.36
Flue-gas analyses:									
CO_2 at air-heater outlet	14.6	13.1	13.9	14.2	14.3	14.4	15.2	14.8	15.2
CO at air-heater outlet	0	0	0	0	0	0	0	0	0
O_2 at air-heater outlet	4.3	5.8	5.1	4.7	4.6	4.4	3.7	4.1	3.7
Total air	124.6	136	132	128	127	126.6	121.1	123.7	120.9
Fly ash, Btu per lb	2781	...	...	...	...	1156	846	1362	909
Slag, Btu per lb	73	...	...	...	...	1227	191	116	46
Heat balance, per cent:									
Evaporative efficiency	87.9	86.48	87.78	87.18	86.50	87.09	87.51	87.02	86.61
Dry flue-gas loss	4.76	5.20	5.10	5.77	6.73	3.54	4.22	4.82	5.04
Moisture in coal loss	1.88	1.78	1.70	1.78	1.71	1.58	1.67	1.59	1.55
Hydrogen in coal loss	4.17	4.04	4.04	4.08	4.10	4.22	4.40	4.42	4.82
Carbon in fly-ash loss	0.50	0.30	0.24	0.21	0.20	0.14	0.15	0.19	0.13
Carbon in slag loss	0.07	...	...	...	...	1.63	0.25	0.16	0.05
Unaccounted for losses	0.72	2.20	1.14	0.98	1.76	1.80	1.80	1.80	1.80
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Auxiliary power, kwhr per ton:									
Forced-draft fans	37.69	43.32	40.31	38.34	37.32	35.55	24.50	36.65	46.93
Induced-draft fans	16.05	9.59	11.34	14.24	14.38	14.29	14.37	16.56	18.00
Coal crushers	1.30[a]		1.5				1.38[a]		
Soot blowers	3.09		5.3			4.92	6.76	4.96	4.53
Miscellaneous	8.85	...	...	...	...	6.03	5.84	4.27	3.91
Total	65.68	...	...	...	...	60.79	51.47	62.44	73.37

[a] Included in miscellaneous.

NOTES:

1. Auxiliary power for Ridgeland coal crushers is average over several months rather than test data.
2. Auxiliary power for Joliet coal crushers and soot-blower air compressors is average of data from two weeks' observation rather than test data.

accounted-for losses were inconsistent. The average of unaccounted-for losses determined in the tests was used to recalculate evaporative efficiencies by the heat-balance method.

It will be noted that carbon loss to slag is high in the Ridgeland test No. 7. This resulted from improper coal sizing and poor combustion conditions wherein excessive quantities of combustible were blasted through the cyclone tap and failed to burn on the furnace floor at low rating.

A 30-deg rise in air temperature through the forced-draft fans is shown. This heat has not been included in the stack loss, neither has it been considered in the evaporative efficiency calculations.

BOILER CLEANLINESS

Undoubtedly a misconception prevailed at the writing of the Calumet paper in the hypothesis that reducing the quantity of ash suspended in combustion gases would reduce boiler-fouling tendency. Some plugging of the secondary superheater lanes with caked dust had occurred at Calumet but the problem had been considered as substantially solved by the addition of three soot blowers. In the Fisk superheaters with higher gas and metal temperatures a severe fouling condition became evident.

A series of events and studies at Fisk show that in the cyclone-firing method, where most of the ash (82 to 90 per cent) is removed as molten slag, the ratio of gaseous alkalies to suspended fly ash is so increased that a bonded form of fouling is prevalent. Three processes are presumed to contribute to this type of fouling, as follows:

1 With low dust loading in the combustion gases, each fly-ash particle as a condensation nucleus is coated with alkali material. Agglomerations of unsintered fly ash were extracted from the gas stream, and tube deposits were found to consist of unsintered spherical particles bonded in an extraneous matrix. This does not imply that sintered and fused formations were not also found in the high-temperature regions.

2 Gaseous alkalies condense directly on the relatively cold tube surfaces causing fly-ash particles to adhere. Table 7 shows analyses of various depositions and a large concretion taken from a front secondary superheater tube and dissected at various distances from the tube surface. Adjacent to the tube metal and about $^1/_{16}$ in. in thickness was a distinctly white deposit. The analyses show high water-soluble salt contents at the tube surface, decreasing with distance from the metal.

3 Reduced dust loading in the gases and the extremely fine particle size probably reduced the erosive or scrubbing action on the fouled surfaces.

FIG. 5 UNIT NO. 18, FISK STATION, VIEWS OF FOULING CONDITIONS ON FRONT TUBES OF SECONDARY SUPERHEATER

In the Fisk furnaces at the entrance to the secondary superheater and slag screen preceding the superheater (1900 to 2250 F gas temperature) heavy slag accumulated and frequently bridged between the tubes. Underlying these protrusions directly on the tube metal was the layer of white deposit. Farther back, in the primary superheater where gas and metal temperatures are lower, caked dust adhered to the tubes. Dust deposits on the induced-draft-fan blades (following the centrifugal dust collectors) necessitated weekly hand-cleaning to maintain fan balance.

After dust loading was decreased by the addition of screen

TABLE 7 ASH DEPOSITS FROM BOILER 18-2, FISK STATION COMPOSITION OF WATER-SOLUBLE PORTION

	Large concretion from front tube of secondary superheater dissected at various distances from tube surface				Encrustations on metal surfaces				
	0 to $^1/_{16}$ in.	$^1/_{16}$ to 1 in.	4 to 5 in.	11 to 12 in.	Sec SH tube, 2nd row	Air-heater tube, cold section	Dust-collector discharge tube	ID fan blades	Dust from collector hoppers
Calcium sulphate, $CaSO_4$	11.2	9.2	10.7	9.0	9.7	5.3	6.6	4.3	...
Ferrous sulphate, $FeSO_4$	11.6	5.9	0.8	0.4	8.6	2.5	8.4	2.8	...
Magnesium sulphate, $MgSO_4$	2.4	1.2	1.2	0.9	1.2	0.6	0.9	1.7	...
Sodium sulphates (sulphate, bisulphate, pyrosulphate) as sodium sulphate[a]	26.6[b]	4.4	0.0	0.0	13.0	10.2	5.4	10.5[b]	...
Acidity (free sulphuric acid, H_2SO_4, and acidity due to bisulphates and pyrosulphates)	Present[b]	Present	None	None	13.5	4.2	13.2	Present[b]	...
Total water soluble	51.8	20.7	12.7	10.3	46.0	22.8	34.5	19.3	12.1
Reaction	Acid	Acid	Alk.	Alk.	Acid	Acid	Acid		

[a] Alkali salts chiefly sodium sulphates; potassium present was not separated from sodium.
[b] Combined sodium sulphates and sulphuric acid.

tubes at the primary furnace, the rate of deposition was such that bimonthly "out of service" cleaning of the superheater and daily cleaning of the fan blades became necessary. Air blowers were installed in the fans and were operated daily. Secondary superheater fouling was also intensified as the secondary furnace walls became covered with bird-nest-type ash deposits. No blowers or facilities for hand-cleaning the furnace walls had been provided. Despite the addition of blowers, more frequent operation, improvements in blower-nozzle design, and trying other media such as steam or water-air mixture, outages for hand-cleaning were necessary. Fig. 5 shows severe fouling at the entrance of the secondary superheater. The installation of secondary-furnace doors for hand-lancing of walls has reduced gas temperature and alleviated superheater fouling to a marked degree.

Fig. 6 shows locations of the original ten soot blowers, locations of the present 16 blowers, steam temperatures, and gas temperatures after the slag screen was altered. Blowers are operated at 8-hr intervals and hand-lancing of the secondary-furnace rear wall, platens, and screen ahead of superheater requires about 20 hr per boiler per week. The bare block quadrant of the cyclone wall is also lanced at 8-hr intervals. For the purpose of reducing the temperature of the gases entering the superheater a fan is to be installed to recirculate gases from the economizer outlet to the top of the secondary furnace. Preliminary tempering tests using air from the forced-draft duct have shown a reduction of gas temperature and lessened fouling of the superheater.

Superheater fouling at Joliet was similar to that at Fisk except that more bird-nest ash accumulated on the platens and front wall of the secondary furnace. The installation of a more extensive screen between primary and secondary furnaces lowered gas temperatures entering the superheater about 100 F and noticeably reduced superheater fouling. Soot blowers in the superheater section were increased from 14 originally to 18, and 4 blowers were installed in the secondary furnace. Greater fouling tendency in the economizer and air heater was experienced at Joliet. Blowers have been installed

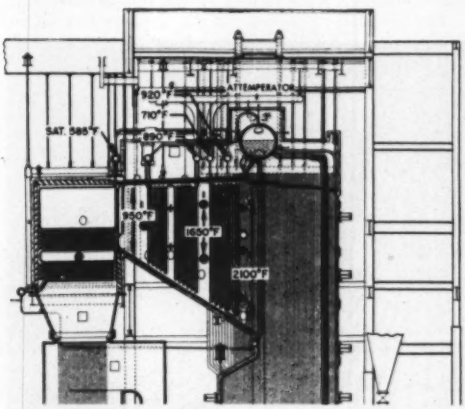

FIG. 6 UNIT NO. 18, FISK STATION, SECTIONAL SIDE VIEW OF SUPERHEATER, INDICATING SOOT-BLOWER LOCATIONS, GAS AND STEAM TEMPERATURES AT FULL BOILER RATING AFTER SCREEN-TUBE ALTERATION

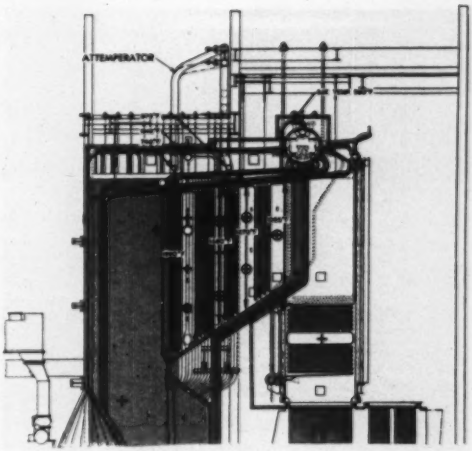

FIG. 7 UNIT NO. 5, JOLIET STATION, SECTIONAL SIDE VIEW OF SUPERHEATER, INDICATING SOOT-BLOWER LOCATION, GAS AND STEAM TEMPERATURES AT FULL BOILER RATING AFTER SCREEN-TUBE ALTERATIONS

in the economizers, and an attempt is being made to reduce air-heater plugging by the installation of suitable directional baffles.

Fig. 7 shows the locations of the original 14 soot blowers at Joliet, the locations of the present 24 blowers, and the pertinent steam and gas temperatures. Fig. 8 shows the fouling condition on top of the air heater, and Fig. 9 shows moderate fouling of the front wall and platen tubes. At this station with no dust collectors, fan-blade fouling does not exist, but blade erosion is occurring to a slight degree.

The following conclusions seem to be reasonable:

1 That reduced dust loading with increased concentration of gaseous alkalies or salts can increase furnace fouling tendency as evidenced by deposits in the lower temperature zones.

2 That salt-subliming temperatures are probably as important a factor in fouling as ash-fusion temperature.

Several authors have published opinions and conclusions similar to those stated. The cyclone firing method has substantiated their findings further.

OPERATING DIFFICULTIES

Difficulties in the cyclone firing method have been related earlier in the paper, such as, interruptions in coal flow from bunker to feeder, irregular coal-feed rate, and furnace-draft fluctuations, Redler conveyer link breakage, and slag-tap cooling-coil failures. A few major problems remain to be corrected.

In the bin system of coal preparation the crusher tends to create a fan action which produces an air flow counter to coal flow and creates a dust nuisance. When coal is wet the output of the crusher is reduced greatly. The fine wet coal packs in the cage openings, and the wet product has a tendency to plug transfer chutes as well as the outlet of the bunker. Frozen coal similarly to wet coal reduces crusher capacity, but to a greater degree increases funneling in the bunker.

FIG. 8 UNIT NO. 5, JOLIET STATION, VIEW OF FOULING CONDITION AT GAS INLET TO AIR HEATER

Fouling of heat-transfer surfaces leaves much to be desired although progress has been made. Operating the boilers at overrated capacity intensifies fouling.

At the writing of the Calumet paper[3] an optimistic attitude prevailed toward freedom from the hazard of explosions. It was reasoned that with low percentage of fines in the coal this hazard was remote. This thought seems justified by the continued experiences with cyclone firing; however, several fires and explosions have occurred that may or may not be associated with cyclone firing and the storage of crushed coal. Several fires occurred in the 30-ton hoppers at Fisk Station. Apparently this has been eliminated by baffling of primary air to the feeders and by more frequent scavenging or trimming of the hoppers. A few bunker or feeder fires occurred at Ridgeland Station, two of which severely damaged the feeders. Origin of the fires is not definitely known. Two puffs or light explosions occurred at Fisk Station damaging the primary-air ducts; both were apparently associated with hopper fires.

On November 28, 1950, a furnace explosion at Fisk followed the intermittent firing of a cyclone, during which time trouble was experienced with the gas torch. Subsequently, a large quantity of unburned coal was found in the primary furnace and it has not been established whether the explosion resulted from distillation of unburned coal or from ignition gas.

In May, 1951, a severe explosion occurred in the coal-handling plant at Ridgeland Station. An investigation developed the supposition that the explosion was the result of gas, principally methane, which was liberated in the bunker from the high specific surface of the crushed coal. Explosive mixtures have been found subsequently in the bunkers, and since then ventilation has been instituted. It is probable that this gas was ignited by static discharge from the conveyer belt. The resulting detonation, although not great enough to damage the bunker, except for lifting the access cover, disturbed coal dust in the conveyer room above the bunkers, then propagated down the inclined conveyer house, and into the junction house.

All of the various puffs and explosions seem to be associated with gas liberation or coal volatilization rather than with dust.

CONCLUSIONS

It is felt that the difficulties experienced are solvable and are now on the way to correction. Troubles did appear and some were expected, especially so during this era of rapid expansion when time was not available for a slow sure pattern of development.

Several of the operating advantages accruing to the cyclone-firing method originally predicted have not been realized, but the outlook for a dependable and suitable method of burning high-ash coal appears favorable. Conclusions to date may be summarized as follows:

1 Cyclone furnaces have reduced greatly the amount of fly ash carried out of the furnace.

2 The maintenance cost of burner equipment and coal-preparation equipment is low.

3 The relatively large-size coal used permits economical use of the bin system of firing with its attendant simplification.

4 Boiler efficiency has met design expectations.

5 Cyclone furnaces will operate successfully on natural gas or oil as substitute fuels.

6 There is a saving of power required to prepare coal for firing; however, the increase in forced-draft-fan power more than offsets the saving in crusher power.

7 Cyclone furnaces have not decreased the fouling of heat-absorbing surfaces when burning Central Illinois coal.

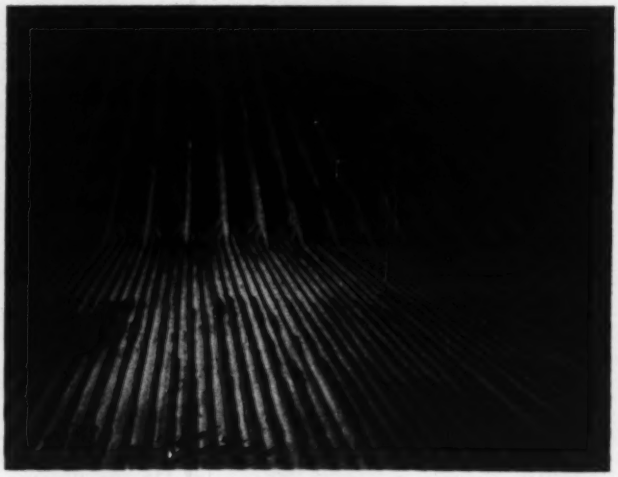

FIG. 9 UNIT NO. 5, JOLIET STATION, VIEW OF MODERATE FOULING CONDITION ON PLATEN TUBES OF FRONT WALL

PROPERTIES *of Some* HEAT-RESISTANT ADHESIVES

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IN RECENT years, heat-resistant adhesives have replaced rivets and other mechanical means of joining materials in several applications that require good strength and performance at elevated temperatures. The most familiar and perhaps the most severe application in the automotive industry is bonding linings to brake shoes. The relationship between the safety of the vehicle and the performance of the adhesive in this application is apparent and indicates the acceptance that high-strength adhesives are receiving. The adhesives also are being used in automatic transmission parts where they play an equally important part in the performance of the automobile.

Figs. 1 and 2 offer examples of automotive applications and the performance of the thermosetting adhesives used in the brake-bonding application. The parts shown in Fig. 1 were obtained from General Motors Divisions and are actual production parts. The brake shoe is bonded with an adhesive in tape form. The tape is tackified and applied to the bottom surface of the lining. The lining is then placed against the brake shoe in a fixture which is passed through an oven for curing. The band shown is a clutch assembly band, and the friction surface is bonded to the steel with a thermosetting resin. The clutch disks shown have the faces bonded with a similar adhesive in cement form. The thermosetting adhesives used for these parts are highly oil resistant (also to hot oils), and their application in transmission parts has resulted in satisfactory and, in many cases, improved service life.

The performance of the thermosetting adhesives used in the brake-bonding application is illustrated in Fig. 2. Three brake shoes with bonded linings that were subjected to a brake dynamometer test and one shoe with a riveted lining taken from service are shown. The brake-dynamometer drum was insulated to subject the bonded shoes to extraordinary temperature conditions. The braking pressure was 500 psi and was applied repeatedly to brake the drum speed from 70 mph to 10 mph. Friction produced the temperatures shown below each shoe. Shoe No. 1 was subjected to 124 braking actions and, as can be seen, the lining has worn away to the bonding surface. However, there was no sign of a bond failure, although a temperature of 945 F was reached. Shoes Nos. 2 and 3 were subjected to 102 stops, and temperatures of 1021 F and 935 F, respectively, were attained. In neither case did the adhesive show signs of failure.

An apparent advantage is obtained by the use of an adhesive in this application which can be seen by comparing shoes Nos. 1 and 4. On both shoes the limit of service life has been reached. On shoe No. 4 the rivet heads have limited the service life of the lining. Complete use of the lining was obtained by bonding with an adhesive as is shown by shoe No. 1.

The heat-resistant, high-strength, thermosetting adhesives are suitable for a wide range of applications since they can be used to join a variety of materials. Facing material on the clutch disks varies from the cork-and-paper type to a metallic-type facing. The adhesives also have shown good adhesion to many metals.

The present discussion will refer for the most part to information that has been collected while developing and improving an adhesive for the brake-shoe application. This application represents one of the most severe in the automotive industry, and the requirements imposed on the adhesives will indicate the range of properties that can be expected of them.

TYPES OF ADHESIVES

There are two general types of adhesives, one based on thermosetting resins and the other on thermoplastic resins. Both types of adhesives generally require heat to form a bond although there are exceptions. The difference between the adhesives lies in their behavior at elevated temperatures. A thermoplastic adhesive is rigid at low temperatures and becomes soft and pliable at high temperatures. A thermosetting adhesive does not change its state after it is once cured.

The thermosetting adhesives are employed in most applications requiring heat resistance and strength at elevated tem-

FIG. 1 EXAMPLES OF AUTOMOTIVE APPLICATIONS OF THERMOSETTING HIGH-STRENGTH ADHESIVES

[1] Junior Engineer.

[2] Senior Project Engineer, Supervisor of Rubber and Plastics Laboratory.

Contributed by the Rubber and Plastics Division and presented at the Annual Meeting, Atlantic City, N. J., November 25-30, 1951, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

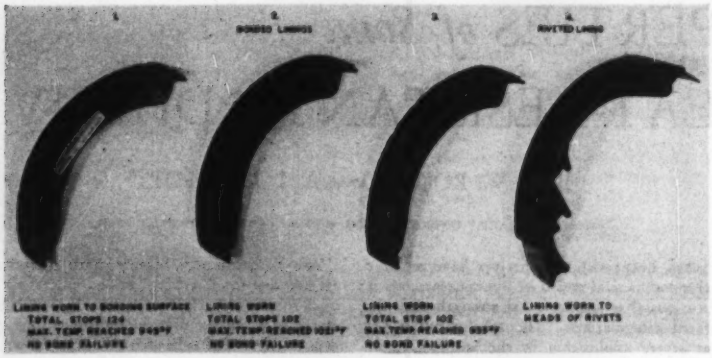

FIG. 2 PERFORMANCE AND ADVANTAGE OF THERMOSETTING ADHESIVE AS BONDING AGENT FOR BRAKE LININGS
(Brake shoes Nos. 1, 2, 3, tested on brake dynamometer; brake shoe No. 4, taken from service.)

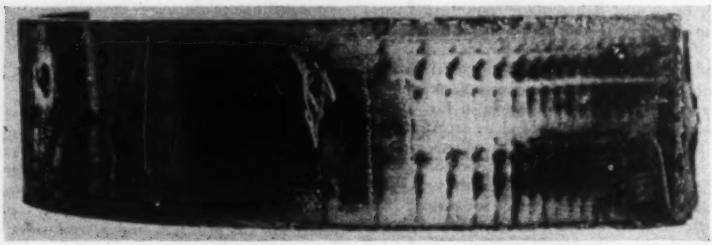

FIG. 3 ILLUSTRATION OF BEHAVIOR OF THERMOPLASTIC ADHESIVE IN A HIGH-TEMPERATURE APPLICATION

peratures. The importance of choosing a thermosetting adhesive for such an application is illustrated very well in Fig. 3 which shows the behavior of a thermoplastic adhesive in a high-temperature application. The bonding surface of a brake shoe tested in a brake dynamometer is shown. The lines running across the surface mark the position of the end of the lining at the end of each application of braking pressure. The temperature increased with each application as a result of friction, and from the distance between the lines it can be seen that the lining slipped more as the temperature increased. When the temperature reached 500 F the lining sheared completely off, leaving an adhesive that was soft and tacky at this temperature. Similar results possibly could occur if a thermosetting adhesive were grossly undercured.

This discussion is based upon heat-resistant adhesive compounds that consist of a thermosetting resin, an oil-resisting elastomer, and various other chemicals that act as activators for the resin, curing agents for the elastomer, and as antioxidants. As a rule the elastomer imparts better impact strength and resiliency to the cured bond while the other ingredients shorten the time of cure and give the adhesive its optimum properties. The elastomer in such a compound provides a base for the powdered resin when the adhesive is used in tape form.

Fig. 4 illustrates the two general forms in which the adhesives are used. The tape is cut in various widths at the factory and rolled for shipment and storage. The tape can be of various thicknesses but is generally from 0.006–0.010 in. The tape is soft, pliable, and essentially nontacky, but as a protection a film of polyethylene is placed between the strips

FIG. 4 EXAMPLES OF THERMOSETTING-ADHESIVE COMPOUND IN TAPE AND CEMENT FORM

of tape to prevent sticking. This is removed before application.

The cement form is used by many companies and generally contains the same ingredients as the tape dissolved in a solvent, such as methyl ethyl ketone, and so forth. The viscosity can be varied for different applications by dilution or by addition of various compounding ingredients to the cement. As a rule, the application of a cement also requires the operation of removing the solvent before the parts to be bonded are assembled.

STORAGE LIFE OF UNCURED ADHESIVES

One of the main problems encountered in the use of adhesive tape is the relatively short storage life of the uncured tape,

especially at temperatures over 100 F which occur frequently in normal storage places. The probable explanation for this is that the same or similar reactions take place at the storage temperatures as occur at the curing temperature but at a much slower rate. It is a safeguard when using adhesives to maintain cool storage temperatures in the range of 40 to 60 F and a small inventory of the uncured adhesive.

An uncured tape adhesive will develop lower flow characteristics upon storing, especially in warm places, and in time will give unsatisfactory bonds. With phenolic adhesives, bond failures change as a rule from cohesion failures to adhesion failures as the storage time of the uncured tape increases. Table 1 illustrates this. Samples of the uncured tape were

TABLE 1 TENSILE TEST FOR MEASURING SHELF LIFE OF UNCURED THERMOSETTING ADHESIVE

Bonding conditions in oven at 400 F under 200 psi for 1 hr; adhesive in tape form; uncured specimens preaged 150 F as indicated

	0 hr	4 hr	8 hr	16 hr
Tensile strength, psi...	4575	4800	5350	4900
Type of bond failure...	Cohesion	Cohesion Adhesion	Cohesion Adhesion	Adhesion

preaged in an oven at 150 F for 0, 4, 8, and 16 hr to accelerate the changes that occur in the tape. The room-temperature tensile strength of steel-to-steel bonds did not change a great deal as the tape was aged, but the bond failure changed from a cohesion failure with fresh tape to an adhesion failure after the uncured tape was preaged 16 hr. Intermediate results were obtained at 4 and 8 hr. The tape was not preaged long enough to show that the tensile strength drops off rapidly, although a slight decline is noted at 16 hr preaging, but the appearance of an adhesion failure is an indication that it will take place. A cohesion failure means failure in the adhesive

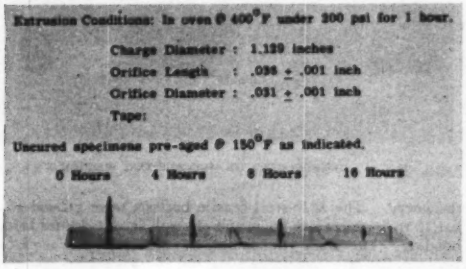
Extrusion Conditions: In oven @ 400°F under 200 psi for 1 hour.
Charge Diameter : 1.129 inches
Orifice Length : .039 ± .001 inch
Orifice Diameter : .031 ± .001 inch
Tape:
Uncured specimens pre-aged @ 150°F as indicated.
0 Hours
4 Hours
8 Hours
16 Hours

FIG. 5 EXTRUSION TEST FOR MEASURING SHELF LIFE OF UNCURED THERMOSETTING ADHESIVE TAPE

itself and the bond between the adhesive and steel or whatever material is being used is very good. An adhesion failure means the adhesive did not adhere to the steel and the best properties of the adhesive are not being obtained. Also, erratic results can be expected when this type of failure occurs.

Perhaps the most applicable way of measuring the present condition of an uncured adhesive is by measuring the properties of the cured bond on the fabricated part. However, this type of test does not determine the reactive life remaining in the tape. The same deficiency is apparent in the tensile test shown in Table 1 since the tensile strength does not change gradually with the age of the uncured adhesive, and the type of bond failure is not reliable as an indication since there are too many other factors, other than age, that affect the type of bond failure.

There are several tests that can be used for measuring the shelf life of an uncured adhesive, however. If the adhesive is a cement, viscosity measurements can be taken. The viscosity increases as the storage time increases, and an indication of the condition of the cement can be obtained by correlation with previous batches.

Control tests for measuring the shelf life of an adhesive tape can be based on the decrease in flow characteristics. Three types of tests will be mentioned.

One method is by extrusion of the tape which is shown in Fig. 5. A sample of the tape, of known diameter and weight, is placed between two metal platens. One of the platens (the top platen in Fig. 5) contains an orifice of specified diameter and length. The platens are then placed in an oven at a desig-

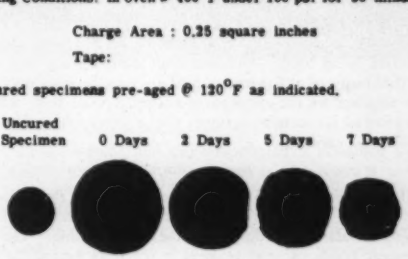
Curing Conditions: In oven @ 400°F under 100 psi for 30 minutes.
Charge Area : 0.25 square inches
Tape:
Uncured specimens pre-aged @ 120°F as indicated.
Uncured Specimen
0 Days
2 Days
5 Days
7 Days

FIG. 6 FLOW TEST FOR MEASURING SHELF LIFE OF UNCURED THERMOSETTING ADHESIVE TAPE

nated temperature, pressure, and for a given time period, in this case 1 hr, at 400 F and 200 psi pressure. The tape was preaged in the uncured condition at 150 F for 0, 4, 8, and 16 hr to illustrate the variation in the extrusion of the tape as it ages. The material shown above the platens has been extruded. A relation can be obtained between the per cent weight extruded and the properties of the cured bond.

Another method, developed by one of the producers of bonding tape, is a direct flow test and is illustrated in Fig. 6. A specimen cut from the uncured tape with a given area and measured thickness is placed between two sheets of cellophane and then between two steel tensile buttons. The assembly is placed in an oven at 400 F for 30 min under 100 psi pressure. These conditions are arbitrary. To accelerate the aging reaction, the uncured tape was preaged at 120 F for 0, 2, 5, and 7 days. The decrease in flow can be seen from the decrease in area of the specimen. A relation can be established between the per cent decrease in thickness and the properties of the cured bond.

The final method that can be used is measuring the elongation rate of the uncured tape. Fig. 7 shows the tape as it is tested. A specimen, in the shape of a flat dumbbell, is cut from the uncured tape and is suspended from a fixed support. A static load of specified weight is applied to the free end. The samples are bench-marked, and elongation is measured over a period of time. The uncured samples were preaged at 150 F for 0, 4, 8, and 16 hr to show the variation in the rate of elongation as the uncured adhesive ages. The variation is noticeable after the static load has been applied 5 hr.

Fig. 8 presents this information in graphical form. Per cent elongation is plotted versus time for each of the preaged samples. The fresh tape exhibits a constant rate of elongation from zero time whereas the aged tape has a high initial rate of elongation which decreases to become constant. The insert shows the difference in the initial elongation of the samples

more clearly. The rate of elongation at any moment decreases as the uncured tape ages.

Other tests whose aim is to simplify and to shorten the time of the test are being investigated. However, all of the tests mentioned are satisfactory as control tests. They give a measure of the present condition of the adhesive and also of its shelf life. For the purpose of this discussion, they show that uncured adhesives deteriorate on the shelf at a noticeable rate.

The tests also are useful when comparing the flow characteristics of various adhesives. This is important since in some applications specific flow characteristics are desired.

CURING PROCEDURE

The thermosetting-type adhesives require heat and pressure during their cure to obtain a good bond. In general, the curing temperature will range from 350 F to 450 F and the pressure from 50 to 300 psi.

The time required for a satisfactory cure will depend upon the adhesive being used. Variations in compounding will affect the time required and a series of tests are usually run to obtain the time required for the optimum or adequate properties. Often a compromise is necessary between the properties desired and the economical cure time.

TEST PROCEDURE

The test results to be presented as illustrating the properties of the cured adhesives were obtained by following SAE and ASTM standard procedures as closely as possible. The data represent bonds of steel to steel in all tests except the shear tests.

Fig. 9 shows the method that was used to assemble the test

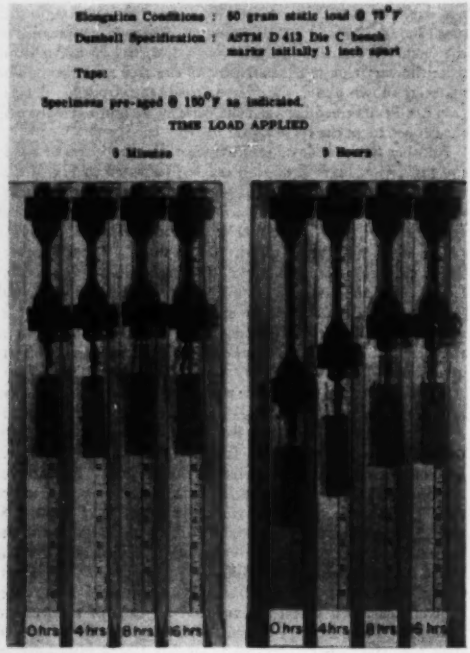

FIG. 7 ELONGATION TEST FOR MEASURING SHELF LIFE OF UNCURED THERMOSETTING ADHESIVE TAPE

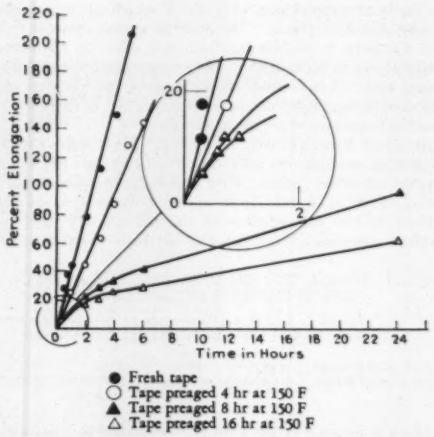

FIG. 8 ELONGATION OF UNCURED THERMOSETTING ADHESIVE TAPES

(Elongation conditions: 50 grams static load at 75 F; dumbbell specifications, ASTM D412 Die C; bench marks initially 1 in. apart.)

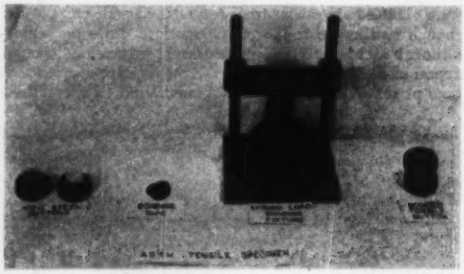

FIG. 9 METHOD USED TO ASSEMBLE TEST SPECIMENS

specimens. The 1020-steel tensile buttons were ground to a flat 10 to 15-microinch finish and electrolytically cleaned before bonding. The round thin sample of adhesive tape was placed between the two tensile buttons and the assembled specimen placed in a spring-loaded bonding fixture. The fixture was then placed in an oven for curing. The completed tensile button is shown on the right.

The tensile strength of the bond was determined on a Dillon tensile tester which is shown in Fig. 10. The machine is equipped with self-aligning grips and has a grip separation rate of approximately 0.050 ipm. A heating jacket was placed around the tensile button while it was mounted in the Dillon machine to make tensile tests at elevated temperatures. The potentiometer and iron-constantan thermocouple for temperature measurement and the Variac for temperature control are shown. Fig. 10 also presents a 100 per cent thermosetting resin cement exhibiting a 2500-psi tensile strength at 400 F.

The heat-resistance tests were made with a cantilever-beam arrangement shown in Fig. 11. The tensile button is bolted to a stationary bar through a ball-and-socket joint for good alignment and the heating jacket placed around it. The button is then fastened by a yoke and pin to a cantilever beam upon which weights are placed to provide a static tensile load on the button.

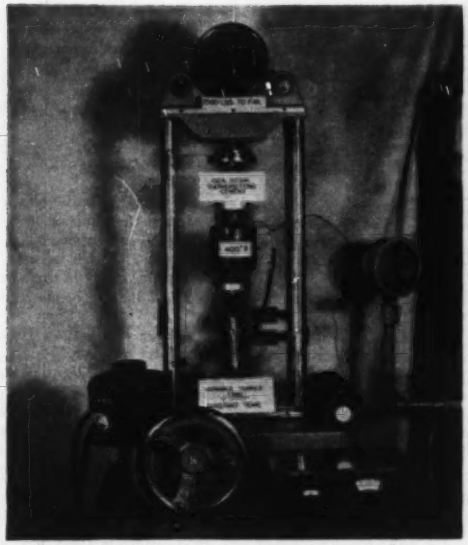

FIG. 10 DILLON TENSILE TESTING MACHINE

FIG. 11 CANTILEVER-BEAM ARRANGEMENT FOR HEAT-RESISTANCE TESTS

The temperature was measured at the bond line with an iron-constantan thermocouple and potentiometer. The temperature is controlled by a Variac attached to the heating jacket.

The heat-resistance tests were run with the test specimen in air. For the test to measure the temperature at which an adhesive fails under a given static load, the temperature was allowed to rise at the rate of 20 to 25 F per min until the bond failed. The static fatigue life at elevated temperatures was measured by holding the temperature constant and measuring the time for the bond to fail. The static fatigue life for an adhesive was considered to be the time that it would support a given load at a specified temperature.

The shear tests were made on a Baldwin Southwark compression and tensile machine. Fig. 12 shows the apparatus prepared for such a test. The lining of the brake shoe is first divided into 1-in. segments. The distance is measured along the circumference of the lining. The lining is approximately $1^3/_4$ in. wide. The brake shoe is then placed on a support which fits under the web of the shoe and against the inside surface of the shoe. The support inclines the shoe 15 deg with the vertical and also acts as the heating element. The

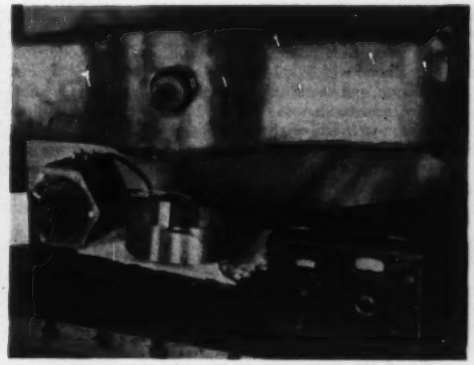

FIG. 12 APPARATUS PREPARED FOR SHEAR TEST

temperature is controlled by a Powerstat shown in Fig. 12, at the left of the fixture, and the temperature is measured by a thermocouple placed at the bond line of the segment under test, and a potentiometer. The load is then applied by lowering the movable head of the Baldwin-Southwark machine and is transmitted to the lining segment through a 1-in-wide, L-shaped steel bracket that is placed over the segment. The dimensions of the bracket are those of the lining segment.

PROPERTIES OF CURED BOND

The bonds obtained with a phenolic-elastomer adhesive after proper curing exhibit high tensile strength, good shear strength, and good heat resistance.

The tensile strength of steel-to-steel bonds after proper curing can reach 3000 to 4000 psi with little difficulty. Table 2 presents the tensile strengths of four representative adhesives that have been given a cure of 60 min at 400 F under 200 psi pressure. The adhesives are all phenolic-elastomer blends. Three of the adhesives have tensile strengths of 4000 psi or more at room temperature which is approximately 75 to 80 F. The fourth adhesive has a tensile strength of 3200 psi at room temperature.

Table 2 also shows the effect of temperature upon the tensile

TABLE 2 TENSILE STRENGTH AND ITS VARIATION WITH TEMPERATURE OF SOME THERMOSETTING ADHESIVES

Phenolic-elastomer blends; steel-to-steel bonds

	Adhesive			
Tensile strength, psi:	1	2	3	4
At room temp	4200	4000	4900	3200
At 200 F	..	2200	..	..
At 300 F	1480	1500	1360	..
At 400 F	900	1000	500	..
At 500 F	100	400	10	900

strength of the steel-to-steel bonds. The tensile strength decreases as the temperature increases, which is a general property for this type of adhesive. Adhesive No. 1 shows a drop in tensile strength from 4200 psi at room temperature to 1480 psi at 300 F, 900 psi at 400 F and to 100 psi at 500 F. The other adhesives follow the same pattern generally but not necessarily to the same degree. It will be noticed that adhesive No. 4, which has the lowest room-temperature tensile strength (3200 psi), maintains this property at 500 F much more than do the other three. Adhesive No. 3 which has the highest room-temperature tensile strength (4900 psi) loses its strength completely

at 500 F. This is one example that illustrates the fact that room-temperature data do not describe the performance of an adhesive at elevated temperatures. In general, the conditions to which a bond will be subjected in service must be taken into consideration, and an indication of the performance of the adhesive under those conditions is required to judge its applicability.

The shear strength of the phenolic-elastomer adhesives exceeds 1000 psi at room temperature. Table 3 presents test

TABLE 3 SHEAR STRENGTH AND ITS VARIATION WITH TEMPERATURE OF SOME THERMOSETTING ADHESIVES

Phenolic-elastomer blends; lining to brake-shoe bonds
Shear loads applied at 15 deg angle given on 1 in. Segment of lining measured along circumference of brake shoe. Width of lining approximately $1^3/_4$ in.

	Adhesive		
Shear load, lb:	1	2	3
At room temp	1820	1480	1700
At 300 F	560	530	650
At 500 F	300	325	320

NOTE: All failures were in the lining 95 per cent minimum.

results that are indicative of the shear strength of three adhesive bonds on a production-type lining and brake shoe. The values shown represent shear compression loads on a 1-in. segment of the lining measured along the circumference of the brake shoe. The width of the segment is that of the lining or approximately $1^3/_4$ in. The load is applied at an angle of 15 deg with the bond line. At room temperature the load for adhesive No. 1 is 1820 lb; No. 2, 1480 lb; and No. 3, 1700 lb.

The effect of temperature on the shear strength is the same as it was on the tensile strength. At 300 F the values for all three adhesives have declined to approximately 530 to 650 lb, and at 500 F to 300 to 325 lb. However, the failures in all cases were essentially of the lining and not of the bond, and these values are actually a measure of the strength of the lining. Nevertheless, the data do show the performance that can be expected with materials of this type.

In general, the heat resistance of the adhesives is good. The upper temperature limit of steel-to-steel bonds, as measured in the laboratory, is approximately 600 F under a 25 to 200 psi tensile load. There have been tests run on bonded brake shoes in a brake dynamometer where temperatures due to friction have intermittently exceeded 900 F without causing failure of the bond. Results of such tests are shown in Fig. 2.

The upper temperature limit for an adhesive seems to depend somewhat on the materials that are being joined. The results previously mentioned indicate that bonds between a material such as brake lining and steel will withstand higher temperatures than steel-to-steel bonds. Laboratory tests also have indicated such an occurrence although the tests have not given results comparable to those obtained on the brake dynamometer. It is thought that the more heat-resistant bonds obtained with the brake-lining material result from venting the gaseous products through the relatively porous lining during the curing cycle. The greater penetration into the lining by the adhesive and the possible compatibility between the resins of the adhesive and the lining also act to reinforce the bond.

The temperature at which a bond fails under a static load as the temperature is allowed to rise at a constant rate, as is done in the laboratory test, is an indication of the upper limit at which an adhesive may be used. The upper temperature limit is given for two adhesives as bonds between steel buttons under various static loads in Table 4. The two adhesives are of the same type, phenolic-elastomer blends, and have essentially the same cure. However, a variation in compounding has resulted in giving adhesive No. 1 an upper temperature limit of approximately 600 F and adhesive No. 2 only 550 F.

TABLE 4 EFFECT OF STATIC LOAD ON FAILING TEMPERATURES OF THERMOSETTING ADHESIVES

Phenolic-elastomer adhesive tapes; steel-to-steel bonds

	Failing temp, deg F — Adhesive	
Static tensile load, psi	1	2
50	620	574
100	640	568
200	602	552
300	604	544

It will be noticed in Table 4 that the change in static tensile load from 50 to 300 psi has not affected the temperature at which the bonds fail to any great extent. For adhesive No. 1, the temperatures are almost identical and although adhesive No. 2 shows a slight trend, the experimental errors in this test together with the natural variations in adhesive bonds tend to make this trend inconclusive.

Steel-to-steel bonds of phenolic-elastomer adhesives have shown static fatigue lives of over 2500 hr at 400 F under a 200-psi static tensile load. However, the fatigue life decreases as the temperature increases. For example, an adhesive that will last for months at 400 F under a 200-psi tensile load may fail in a few hours at 600 F and a 25-psi tensile load. The static fatigue life of a cured thermosetting adhesive is essentially indefinite at temperatures below 300 F under a 200-psi tensile load.

CONCLUSION

The adhesives have given very good service in their present applications as is indicated by the performance of the millions of brake shoes and transmission parts in the automotive industry using such adhesives. However, continual improvement is a necessity in any product. Further development is being carried out on the phenolic-elastomer adhesives to improve the physical properties of the adhesive bonds, and there is an indication that such improvement can be accomplished with the materials in use today.

ACKNOWLEDGMENT

The authors wish to thank Mr. W. M. Phillips, members of the Research Division, and other G. M. Divisions for their encouragement, technical help, and test data.

A PROCESS which makes possible the manufacture of a tough, transparent vinyl plastic film in thicknesses of 0.001 in. or less was announced recently by the Naugatuck Chemical Division of the United States Rubber Company.

The process is expected to open up extensive markets for vinyl film in industrial and consumer packaging.

It also makes possible large volume sales of vinyl film directly to the consumer in roll form for household uses.

The process, developed in Naugatuck Chemical laboratories, utilizes a method known as "blow extrusion" where the film, which is based on Marvinol VR-10 resin, is extruded through a circular die at temperatures between 375 and 425 F.

The film can be produced in widths exceeding 100 in. and in thicknesses of as little as 0.0003 in. At this thickness it is possible to obtain 50 sq yd of film from one pound of raw material.

The film is extremely strong and durable with excellent clarity and good insulating properties. It can be produced in a wide range of bright colors and its cost is competitive with other types of plastic-film materials. An added advantage is the fact that it can be produced with a soft flexible feel or stiff and paper-like.

OPERATING EXPERIENCE *of* THE *Talgo* TRAIN

By ALLEN W. CLARKE

CHIEF ENGINEER, PASSENGER CARS, AMERICAN CAR AND FOUNDRY COMPANY, ST. CHARLES, MO. MEMBER ASME

DESIGN principles, construction details, and demonstration test results of the Talgo train were given in a paper presented at the 1949 ASME Annual Meeting in New York, N. Y.[1] Since that time two trains were shipped for operation on Renfe, the Spanish National Railways. The trains were checked and ran in test operation for about six months, finally being placed in revenue service between Madrid and Irun on July 14, 1950.

BACKGROUND

Briefly, the basic feature of the Talgo trains is their light weight. The cars are of all-aluminum construction and have a weight per passenger which is approximately one quarter the weight of a conventional car per passenger. Advantages of this extreme lightweight are reflected in much lower fuel costs, reduced maintenance costs, and less wear on the right-of-way.

The Talgo cars are four feet less in over-all height than conventional cars and have a center of gravity which is two feet below the center of gravity of conventional cars. The cars are suspended near their center of gravity and the floor of the cars is only 18 in. above the rail.

Perhaps the most important feature giving the lightweight Talgo its safety and roadability is the guiding of the axles. Each car has only one axle. This axle is placed at the rear of each unit and is fixed at right angles to the longitudinal axis of the car. When the train is coupled, the front of each car is supported by the rear, or axle end, of the preceding car, thus presenting a series of coupled trailers. When the front part of a trailer goes into a curve, it moves laterally with the curve. Since the axle at the rear of the car is fixed at right angles to the longitudinal axis of the car, the wheels are turned into the curve before the flange contacts the curved rail. In other words, each car is steered through curves by the couplings of the preceding car. Since the axles are steered through curves, weight is not important in keeping the flanges of the wheels from climbing the rails.

OPERATION

The two ACF Talgo trains have been in revenue service in Spain for about $1^1/_2$ years, offering three round trips per week between Madrid and the French-Spanish border town of Irun. The distance between the two terminal stations is approximately 400 miles.

Few people realize that Spain is second only to Switzerland as the most mountainous country in Europe. From the standpoint of railroad operation, this means difficult grades, curves, and altitudes. The route traversed by the Talgo ranges in elevation between sea level and 4500 ft, has grades in excess of 2 per cent, and has no long, level, high-speed stretches such as we know in America. In spite of the adverse nature of the terrain and the poor maintenance of the lightweight Spanish rails, the 400-mile run, including seven intermediate stops, is made in $8^1/_2$ hours at an average speed of nearly 50 mph. The internationally known Sud Express, with conventional equipment, takes more than 13 hours to make the same trip. The secret of the faster schedule is Talgo's ability to maintain higher average speeds. Because the wheels are steered through curves, the train is capable of higher safe speeds on curves. This is not only a time-saver in itself, but greatly reduces the minutes lost in slowing down before and accelerating after curves. Another factor contributing to higher average speeds is lightweight. The car weight per passenger is low and the trains have a most favorable ratio of tractive horsepower per ton of train weight. (The present ratio is about 7 hp per ton.) This means rapid acceleration.

During each 400-mile run, an average of 45 min is lost in waiting for connecting trains, clear track, roadwork, and similar delays. In spite of this average loss, the Talgo has a record of 98 per cent on-time arrival at its terminal points.

During the test period, the Talgos were run up to 100 mph over the rough Spanish tracks. In revenue service, however, the top speed limit is 75 mph. On several occasions, trains have been delayed in their 400-mile route by as much as $1^1/_2$ hours and have still arrived at their terminal stations on time. This performance brings the average speed for the actual running time to well above 60 mph. Like all modern streamline trains, the Talgos have been designed to operate as complete trains. However, cars can be switched in and out to meet traffic demands.

Since there is an observation car, the trains are designed to operate in one direction. Talgo trains can be backed up but when so doing do not have the advantages of the guided-axle system. They have been reversed for continued periods at speeds up to 50 mph. In this case the wheels act like the wheels of conventional cars. They are turned when the flanges of the wheels are forced against the curved rails. Because of the light weight, it is not considered wise to operate in a reverse direction at excessively high speeds.

As with all modern streamline trains operating with an observation car, the Talgo is turned around on a Y or some other turn-around combination. They are designed to negotiate 22-deg curves which makes them flexible and easy to handle in switching and turn-around operations.

PUBLIC REACTION

The Talgo trains are without doubt the most popular trains in Spain and the most talked about trains in Europe. One month after the trains had been put into revenue service, there were waiting lists for tickets. In response to a brief survey conducted at the end of 1950, it was found that the Talgos had carried many passengers who had formerly preferred making the same trip by automobile. It was also found that passengers had been attracted who formerly would not have made the trip at all. Meanwhile, conventional express trains operating between the same points have recorded definite declines in traffic.

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[1] "The Talgo Train," by J. M. Gruitch and O. H. Philips, MECHANICAL ENGINEERING, vol. 72, 1950, pp. 787–791.

Contributed by the Railroad and Oil and Gas Power Divisions and presented at the Annual Meeting, Atlantic City, N. J., November 25–30, 1951, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Condensed.

The Talgos operate as extra-fare reserved-seat coach trains, offering between 128 and 176 salable seats, depending on the traffic demand, which varies with the seasons. While the one-way trip is 400 miles, the average passenger travels 280 miles. The coefficient of utilization, i.e., the ratio between passenger miles traveled and miles offered—is about 55 per cent. The coefficient of occupation, i.e., the ratio between the passengers carried per trip and the seats offered per trip—is close to 80 per cent. Both figures are a tribute to the train popularity, which is due to its comfort as well as its speed.

In the spring of 1950, one of the Talgos was taken to Portugal for demonstration. One of the most important trips made during that ten-day visit was a round-trip demonstration run between Lisbon and Oporto. These two cities are normally connected by American-built coaches pulled by modern American-built Diesel-electric locomotives. Modern though this conventional equipment may be, it is limited to a top speed of 50 mph over the somewhat irregular Portuguese track. Greater speeds have been found to produce uncomfortable vibrations and movements. When the Portuguese railroad officials allowed the Talgo to make a demonstration run between these two cities, it, too, was limited to a top speed of 50 mph. It was not long, however, before the Portuguese officials realized that 50 mph meant nothing to the comfort of this train. Gradually they permitted an increase in speed. On the return trip from Oporto to Lisbon, the Talgo set a new official record between the two points. Most of the officials did not even know a record was being made. They were so comfortable that they fell sound asleep. The top speed attained during the record-breaking run was about 85 mph. Even at this speed there were no signs of uncomfortable vibrations or movements such as those experienced in the modern conventional equipment at speeds above 50 mph.

Another reason for Talgo's popularity is its clean, all-weather, air-conditioned comfort. During the first summer in service the Talgos became known as the coolest spots in Spain. Summer temperatures in Spain often go above 100 F, and yet temperatures in the Talgo trains have never been recorded above the middle seventies.

The air-conditioning units for the Talgo trains are housed in the equipment cars. Each equipment car services about four coach units or 64 passengers. The weight of all air-conditioning and electrical equipment in each equipment car is less than one ton. The weight of the equipment performing the same service in a conventional coach is about 8 tons. The heating of the Talgo cars is accomplished by blowing air across electrical strip heaters. The cooling of the cars is accomplished by blowing air across Freon-charged evaporator coils.

Because of the length of the Talgo's run, meals are served en route. Small kitchenettes in the equipment cars have icebox facilities, large thermal containers for the storage of hot foods and liquids, and electric grills for the preparation of simple hot dishes. Preboxed meals supplemented by some hot or cold dishes from the kitchenettes are served to the passengers on trays which fasten to the seats. The food service is similar to that used in airplanes.

One of the most noteworthy events in the story of Talgo's operation occurred early last summer. While traveling north at 50 mph, one of the trains was erroneously switched into the last eight cars of a slow southbound freight. As an indication of the force of the collision, four of the freight cars were completely demolished and four were damaged beyond repair. A harvesting machine which was loaded on a flatcar was later found on top of a nearby two-story building. Both north and south main lines were tied up for nine hours before the wreckage could be cleared and the rails straightened. Surprisingly, not a single passenger was injured. The only passengers that even knew of the collision were those riding in the cars which had collided directly with the freight train. The others noticed the jolt, but assumed that it had been caused by an emergency brake application.

The Talgo cars directly implicated in the collision were not seriously damaged. Because of their light weight, they were moved aside by the impact. The cars not directly implicated in the collision were not damaged in any way and did not jackknife or derail. This can be explained by the rigidity of the coupling between the cars and the lesser inertia of such lightweight equipment. While nearly all of the freight cars involved in the collision were overturned, passengers and crew members in the passenger train reported that there was not even a lurch in a lateral direction.

Several railroad officials were passengers at the time of the accident. Afterward each wrote a report or letter and these were published in the newspapers. Each emphasized that had the same accident occurred with conventional equipment, there would have been many injuries and undoubtedly some fatalities. While the accident was regrettable, it has engendered an even greater respect for the Talgo trains.

MAINTENANCE AND COST

The maintenance of the Talgo trains is as favorable as its advanced operating characteristics. The Talgo locomotives are not only traction units but headend power units, and carry the water supply for the entire train as well as supplying all electricity for air conditioning, heating, and lighting. The auxiliary service power is provided by two 170-hp Diesel-alternator sets. The use of headend power has proved very satisfactory, since it demands little extra maintenance in the locomotives and completely eliminates the repetition of maintenance operations on comparable equipment on each car of the train.

Traction power for the locomotives is provided by two 405-hp, high-speed, V-8, automotive-type Diesels. These engines have proved very economical, giving the remarkable figure of approximately two train-miles per gallon of fuel. This fuel economy is particularly remarkable considering that it is achieved in the high-speed transport of 178 passengers. The Talgo locomotives are subject to about the same maintenance requirements as are all Diesel-electric locomotives.

The maintenance of the Talgo cars is simple. There is nothing under the cars to maintain except the running gear and brake equipment. The running gear itself is a simple single-axle affair and is much easier to maintain than the more complex conventional truck. Maintenance of the Talgo cars is really much like maintenance of an automobile. Every few thousand miles the trains are run over service pits, inspected for possible road damage, and then greased by the same means as is used in greasing an automobile. There are only six grease points per car and they are readily accessible. The routine maintenance operation for each car takes only a matter of minutes.

The car wheels are supported by roller bearings. These bearings are placed in an accessible position and are easily repacked every 50,000 to 60,000 miles.

The wheels of the Talgo cars have excellent wear characteristics. Periodic examinations have shown that for every 100,000 miles traveled, the average tread wear is less than $^3/_{16}$ in. This low wheel wear is due in part to the light weight of the cars and in part to the elimination of wheel-tread brake shoes.

The brakes used on the Talgo cars have internally expanding hydraulic brake shoes similar to the type used on automobiles. These hydraulic brakes are actuated by a master cylinder using air pressure from the air-brake equipment of the locomotive. Hydraulic brakes have proved efficient, trouble-free, and as

(*Continued on page 380*)

The Transit Van System of TRANSPORTATION

By JOHN R. ALISON

PRESIDENT, TRANSIT VAN CORPORATION, REDWOOD CITY, CALIF.

THE Transit Van System is a method for correlating the basic modes of transportation—rail, truck, ship, and aircraft—through the use of standard vans easily and efficiently interchangeable between the carriers utilized in these phases of our transport economy. The fundamental objective of the system is to provide a better and more efficient service throughout the entire movement of freight from original shipper to ultimate consignee. The system is designed to accomplish this objective (1) by exploiting the inherent economic advantages of each mode of transport, and (2) by facilitating the rapid transfer of cargo from one mode to another without costly and time-consuming delays.

Underlying the impetus behind the development of this concept of transportation service is a fundamental economic conclusion, namely, that progress toward efficiencies in the production of goods has not been matched, during the past half-century, by corresponding progress toward efficiencies in the distributive process. This applies not only to marketing and merchandising generally but to transportation specifically.

For example, two years ago there was an analysis of the cost of producing apples in Washington State and bringing them to the housewife in Chicago. Out of every dollar spent in this product by the ultimate consumer, 74 cents were expended for services related to the distributive process: wrapping and packing, freight charges, auction services, and wholesale and retail marketing functions. These costs were nearly three times the cost of producing the article.

In the marketing of Florida oranges in New York, the growers' return amounted to 19 cents out of every consumer's dollar, while 81 cents represented the cost of transportation and other phases of distribution.

Turning to transportation specifically, a 1948 report on domestic shipping by one of the large U. S. steamship operators states that cargo-handling expense alone absorbs almost half of the gross freight revenues of the domestic shipping industry.

Another example in the transportation field: during a transcontinental movement of freight spanning an interval of some 10 or 11 days, the average freight car spends more than five days in terminals. During its entire life, the average railroad freight car spends only three hours out of every 24 producing transportation—and during those three hours it moves at an average speed of slightly over 20 mph.

DESCRIPTION OF TRANSIT VAN AND EQUIPMENT

The transit van used in the Transit Van System is, in effect, the van or freight-carrying portion of a truck or trailer, Fig. 1. Volume and carrying capacity are variable within limits; however, the objective is standardization. Experience may indicate that several standard sizes are required. Early prototypes constructed for rail and highway tests are approximately 20 ft long × 8 ft high × 8 ft wide, containing somewhat over 1000 cu ft of loading volume, and a pay-load capacity of approximately 30,000 lb. These van units, independently of any outside carrier, have mobility on small castering wheels adjacent to the four corners. These wheels are extended or retracted, and thus the van is raised from or lowered to its own base, by means of hydraulic rams and legs. To promote efficient loading and unloading of freight, the end doors provide full access to the end of the van; a smaller curbside door is optionally furnished. The interior design of the van facilitates the rapid application of means for securing the lading, thus reducing the need for packaging and heavy and expensive dunnage and bracing.

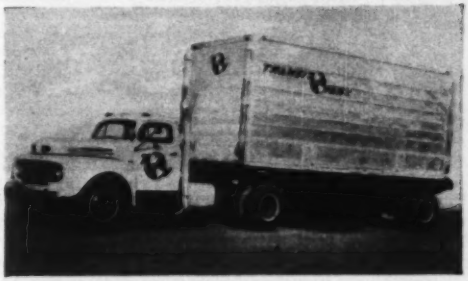

FIG. 1 TRANSIT VAN AS INTEGRAL PART OF HIGHWAY TRANSPORTATION

The means of effecting interchange of the van between surface carriers is based upon the use of standard existing flatcars, truck-trailer, and other line haul equipment. The minor modifications made in these facilities in no way affect their utility for other transportation operations. On the contrary, the mechanized interchange of freight between motor carrier and other modes of transport materially increases the rate of utilization not only of the truck-trailer equipment but also the railroad flatcar, steamship, or cargo airplane.

The truck-tractor used in the System may be any conventional truck of appropriate capacity. The only special equipment required on the truck consists of a power take-off and a hydraulic pump and accessories. These devices are standard, being comparable with those installed for use in conjunction with trailers equipped with dump bodies or hydraulic tail gates. The semitrailer unit employed in the System similarly can be any conventional flatbed trailer unit; single-axle models with an over-all length of about 22 ft were used with test prototypes. The equipment for transferring the van to or from the trailer consists of accessories installed on the trailer unit and certain facilities which can be carried in the toolbox or stored at the terminal.

The equipment installed on the trailer unit includes the following:

Contributed by the Aviation and Materials Handling Divisions and presented at the Annual Meeting, Atlantic City, N. J., November 25-30, 1951, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

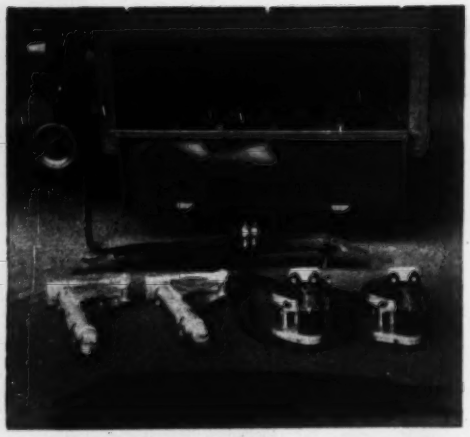

FIG. 2 PORTABLE TRANSFER MECHANISM CARRIED IN TOOLBOX OF TRAILER

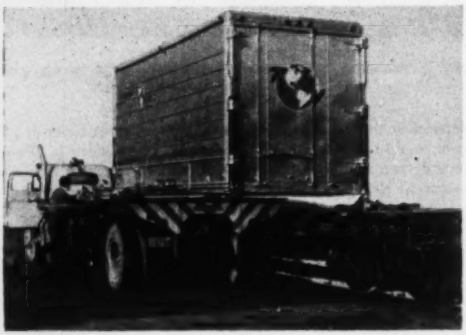

FIG. 3 RAPID TRANSFER AT EXISTING FACILITIES WITHOUT SPECIAL PREPARATION

1 Guide rails and wheel stops at each end of the flat bed to position the van on the trailer.

2 Two racks countersunk laterally in the deck of the trailer to accommodate pinion gears and hinged extension arms of the same material mounted on the side of the trailer and aligned with the racks.

3 A plate countersunk in the deck at each end for insertion of a removable cone-shaped pin which engages the van when spotted on the trailer. This arrangement prevents horizontal movement of the van on the trailer deck. A device fitting into each end of the van and also engaging the trailer locks the van against vertical movement.

4 Hydraulic lines, valves, and controls to provide means for powering the transfer system.

The portable transfer accessories, Fig. 2, carried in the toolbox of the trailer consist of the following:

1 Two hydraulic power units, each of which provides a 4-ton push or pull force applied through pinions engaging the rack in the trailer deck. The combined effort of these units is capable of moving a fully loaded van up a 35-deg incline.

2 Small dollies for mounting the power units on the trailer when making a transfer. The extension arms on the dollies are provided with hooks which engage pins countersunk in the side of the van.

3 Two articulating bridging rails. The wheels of the van roll on these rails when the van is being moved between trailer and flatcar or dock. These rails permit transfers to be made even though the trailer and the recipient unit are at different heights or are out of parallel with one another.

This arrangement of mechanical features incorporated into a transfer system for demountable freight units was developed in an effort to avoid the limitations and disadvantages of earlier methods. Specifically, it was designed to meet the following requirements:

1 Allowing complete transfers to be made quickly by a single, semiskilled operator, Fig. 3.

2 Elimination of need for costly terminal facilities. A transfer of the van can be readily effected wherever a trailer can be drawn alongside a flatcar or dock.

3 Retaining the utility of the carriers' equipment for other transportation operations when it is not engaged in carrying transit vans.

4 Reliability, simplicity, and economy of all equipment and mechanism under all operating conditions.

FACTORS AFFECTING SIZE

In determining the size of the van, no scientific yardstick was found that could be applied—the determination was a result of a number of compromises. To some extent, the outer boundaries were dictated by legal or other similar factors. For example, since the shipping van is to be utilized on motor vehicles, its dimensions must conform to state highway limitations. This places a limit of 96 in. on the width of the unit. Similarly, the maximum legal vehicle height is 12 ft 6 in., and since most trailer frames are approximately 4 to $4\frac{1}{2}$ ft high the maximum height of the van is set at about 8 ft.

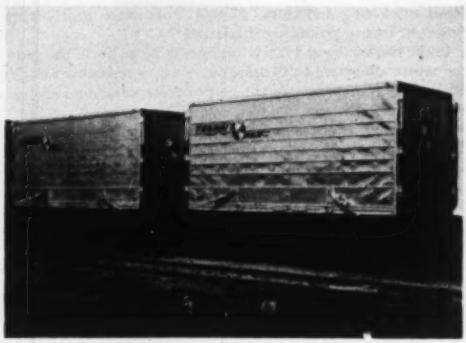

FIG. 4 TWO TRANSIT VANS PROVIDE CARLOAD SERVICE

The selection of a suitable length for the transit van is somewhat more complex. In some states the permissible length of a highway semitrailer runs as high as 45 ft, although in most states shorter limits prevail. But many other factors must be taken into account in making a satisfactory selection, and most of these are operational and economic in character. From an operational viewpoint, the most important considerations appear to relate (1) to the feasibility of providing prompt and efficient pickup and delivery through the service of one man

operating one piece of equipment, and (2) the practicability of maneuvering the equipment around congested terminals and through city streets. These factors tend to limit the length of a van unit to approximately the range of 20 to 24 ft. From an economic standpoint, the important factors include (1) the quantity of merchandise which consignees seek to purchase to meet minimum inventory requirements, (2) the economic flexibility of transportation equipment in a combined line haul and pickup and delivery operation, and (3) the economic necessity of utilizing to the maximum the capacity of line haul railway equipment. An evaluation of these factors likewise leads to the conclusion that a unit of approximately 20 to 24 ft in length has many advantages. One of the reasons for this is that a transferable body of about this size, capable of use with semi-trailers, can be utilized in some of the states as a double trailer combination which can be broken down into two delivery units at destination.

Transferable van bodies of about this length also co-ordinate economically with other modes of surface transportation. Two such units, for example, may be placed on a 45 to 50-ft railway flatcar and provide an aggregate capacity approaching that of an average boxcar, Fig. 4. If the unit were appreciably longer than the indicated range, one of two results would ensue: either an exceptionally long flatcar, of which there are relatively few available, would be required to accommodate two units, or the car would have capacity for only one body unit with resultant underutilization of the rail equipment. Experience reveals, also, that a 20 to 24-ft van body can be effectively correlated with steamship and barge operations. Any longer units would be difficult to maneuver on board the vessel, even as deck cargo; moreover, its gross weight would tend to exceed the capacity of all but the largest winches.

It is probable that further experience will show the advantage of offering a service with a somewhat smaller van unit—perhaps in the range of 12 to 14 ft in length. There appear to be situations in the pickup and delivery of freight and in the inventory and merchandising practices of consignees where a unit of this capacity provides greater economic potentialities than the larger van. In its relation to carriers' equipment, moreover, a transferable body of this size seems to be sound. In the case of motor vehicles, for example, the van would be ideally suited to operations with what is popularly known as a "bobtail" truck—an integral truck unit with a flatbed on the truck chassis itself. There are many distribution activities, particularly in congested cities, where this is the only type of unit that can effectively be used. On the railroad, a 12 to 14-ft van correlates with existing equipment since a 45 to 50-ft flatcar can readily accommodate three vans of this size.

This system of demountable bodies need not be restricted to vans. The fundamental principles can be applied equally as well to a variety of specialized types of freight containers, such as refrigerated units for a wide range of perishable products, hopper units for many categories of bulk shipments, tank units for the shipment of liquids, or even flatbed units for such items as lumber or heavy machinery. As applied to military operations or specialized commercial applications, the principles of interchangeable units capable of transfer from one form of transport to another can readily serve still more specific problems. For instance, a van might be equipped as a complete field office, machine shop, laundry, or base hospital unit.

ELEMENTS OF A TRANSPORTATION SYSTEM

A system of transportation employing demountable freight bodies entails much more than the equipment and the related facilities for its use, even though it is recognized that such equipment and facilities must necessarily be engineered on the basis of sound mechanical design. In order to be effective, the system must also incorporate a complex of interrelated elements. A few of the more important elements are as follows:

1 The system must include a new type of rate and tariff structure designed to assure the sound development of a van or container service. The structure should seek to accomplish a number of objectives, including the promotion of through-shipments of vans on a single shipping document although entailing carriers engaged in two or more modes of transportation; the capitalization of the inherent economies of each mode of transport; the provision of rates for quantities comparable to the capacity of the van rather than tailored to the carload rate structure of the railroads; and the introduction of rates effectively competitive with other conventional forms of transportation.

2 The system must include schedules and related transportation services designed to meet adequately the requirements of shippers and consignees. For example, in a fast merchandise freight service with vans, entailing the combined use of truck pickup and delivery and rail line haul operations, the schedule of the truck and rail phases must not only be co-ordinated with one another so as to take maximum advantage of the rapid transfer of freight from one to the other but also with the shipping and receiving requirements of the customers. This involves not only suitable co-ordination with the shippers and consignees to determine the time of day for pickup and delivery but also the adoption of schedules for the entire service to assure that the total elapsed time is competitive with that offered by other carriers.

3 The system should include the establishment of suitable organizational arrangements within the carriers' staff to assure that the van service is so promoted that it will occupy its appropriate role in their entire transportation activities. It is doubtful, for example, whether freight traffic representatives concerned principally with the promotion of carload traffic are the best means of encouraging the development of a new type of van service. Similarly, carriers might find it necessary to change their procedures for creating shipping documents and handling the related accounting problems in order that the paper work connected with an accelerated van service can keep pace with the movement of the commodities.

4 The system should include revisions in existing packaging and stowing requirements and appropriate changes in practices connected with recognizing and settling freight loss and damage claims. For instance, the use of a fractional carload shipping unit, together with the reduction of freight handling and exposure at terminals, make possible substantial economies in packaging which should be passed along to the customer in simplified packaging requirements. The material reduction in the loss and damage to freight moving in a container service should likewise inure to the benefit of the shipper and consignee through simplifications in tariffs and reductions in freight rates. Since a container service facilitates the assignment of responsibility for such losses and damages as do occur, it should be possible for carriers to "streamline" their settlement of freight claims.

APPLICATION OF SYSTEM TO AIR TRANSPORTATION

Application of the Transit Van System to air transportation will have to await the development of aircraft of sufficient capacity to carry the elements of the system. The C-124 now in production for the Air Force will accommodate three full-scale vans. However, the requirements for this aircraft did not include accommodation of a van system and therefore the usefulness for this purpose will be limited.

In the development of future cargo prototypes a primary ob-

ject will be the reduction of the direct costs of air transportation. It is almost certain that material reductions in direct costs will be accompanied by increases in transportation capacity through increases in aircraft speed and, within limits, aircraft size. With the continued development of aircraft power plants, speeds in excess of 400 knots and cargo capacities of 100,000 lb or greater are feasible. It is to be expected that aircraft of this size will be developed as military prototypes and eventually will find their way into commercial application.

As the development of large cargo aircraft takes place there will be a necessary requirement for the development of rapid means for loading and unloading the relatively large cargo volumes in order that the utility of the aircraft can be maintained at the highest practicable level. However, the requirement does not end with the loading and unloading of the aircraft. New techniques for speeding the cargo between the aircraft and the receiver or shipper must be developed if the total transit time for air cargo is to remain consistent with the speed of modern air transport.

At present, ground handling time for air cargo approximates 50 per cent of the total transit time for long-haul domestic operations and up to 90 per cent of the total transit time for short-haul operations. For cargo operations of 1000 miles the cost of ground handling the cargo is approximately 20 per cent of the total costs. These ratios increase for shorter flights and decrease when the distances flown are longer. Ratios cited were developed from experience with aircraft with speeds less than 200 knots and carrying capacities less than 10 tons.[1]

As aircraft speeds and carrying capacities continue to increase with the development of improved cargo aircraft a seriously uneconomic relationship will develop between air and ground times as related to total transit time unless equipment and systems are developed to keep the speed of ground operations in step with the speed of modern aircraft.

It is felt that the transit van offers a solution to the problem by providing the following:

1 A method for assembling, securing, and balancing the cargo load prior to the arrival of the aircraft at the air terminal.

2 A method for mechanically loading and unloading the aircraft with resultant savings in time and labor.

3 A method for by-passing freight-handling operations at the airport.

4 A method for the reduction of loss and damage which occurs primarily in the ground handling phase of air operations.

5 A method for efficient interchange of air cargo with surface means of transport.

6 Another important contribution not related primarily to economics is provision of a method to shift cargo operations quickly from one area to another in times of national emergency without the requirement for fixed terminal installations.

It should be pointed out that provision of the equipment to accomplish the foregoing objectives is not in itself enough. An earlier part of this paper has described how the equipment must be used in a system where the relationship of rates, operational schedules, and business techniques have been chosen to develop and make full use of the advantages inherent in this type of transportation operation.

It should also be noted that there are types of cargoes not suitable for transportation in vans and aircraft design must incorporate provisions for interchangeability between vans and other cargo.

This paper has considered means for introducing new efficiencies into transportation by proposing a system for correlating the several methods of transportation. It is expected that this system will shorten transit times with improvements in cargo handling and distribution efficiencies. As it applies to air transportation the system has far-reaching importance. Speed in air transport and air-cargo handling is not just a commodity sold to the shipper but has an important role in the reduction of air transportation costs. As the speed, carrying capacity, complexity, and costs of modern aircraft increase it becomes important to speed up all supporting operations related to the operation of the aircraft. Among the most important of these is the ground handling of air cargo. The full implications of the Transit Van System to air transportation will not be known until actual tests have been conducted. In the meantime, it affords an interesting avenue of study into this important problem.

[1] "Improvements Required in Air Cargo Ground Handling," by R. Dixon Speas. Paper No. 49—A-131. Presented before the 1949 ASME Annual Meeting, New York, N. Y.

Operating Experience of the Talgo Train

(*Continued from page 376*)

easy to maintain as automobile brakes. On the basis of operational experience, it has been found that the car brake shoes have a life expectancy in excess of 100,000 car-miles. In addition to extremely long brake-shoe life, braking is so efficient that on level track, the fully loaded Talgo can be brought to a full stop from a speed of 60 mph in less than a quarter of a mile.

The maintenance of the coach interiors is simple, requiring cleaning only. The equipment cars housing the kitchenettes, the lavatories, electrical control equipment, and the air-conditioning units were so designed that all parts demanding maintenance are easily accessible.

Preliminary cost studies on the operation and maintenance of the Talgo trains are being made in Spain. It is difficult to make an exact conversion of these figures from Spanish prices and methods to American prices and methods. However, Renfe, the Spanish National Railways, have studied the costs and state that if they were to replace all of their existing equipment with Talgo trains, they would achieve a saving in excess of 66 per cent. Spanish railroad equipment is not as modern as American equipment and Spanish methods of operation and maintenance are not as efficient as American methods. Nevertheless, it seems reasonable to assume on the basis of the Spanish costs, that Talgo trains could be operated in the United States as well as in other countries at less cost per mile than the best of the modern conventional streamliners.

CONCLUSIONS

When the first test unit was placed on the U. S. tracks nearly three years ago, the operational advantages of the new design were merely theoretical. After $1^1/_2$ years of actual revenue operation, most of these have been proved. In daily operation, the Talgos are making faster schedules, while a positive public reaction is paying tribute to the comfort and safety of the new equipment. Railroad men in Europe have expressed interest in the Talgos. While some were skeptical at first, many now realize that the Talgos are flexible on the road and in the yards, that they are easy to maintain, and that the direct operational costs are very low. European railroad men have developed a definite interest in the Talgos—so pronounced that it would not be surprising to hear of the inauguration of new Talgo services in important European countries within the next five years.

Operating Experiences With STATIONARY GAS TURBINES

By PAUL R. SIDLER

PRESIDENT, BROWN BOVERI CORPORATION, NEW YORK, N. Y. MEMBER ASME

PRESENT-DAY designs are based on several decades of activity and experience in the gas-turbine field, highlighted by such milestones or pioneering contributions as the Holzwarth gas turbine, 1909; Velox boiler with gas-turbine-driven charging set, including the first practical axial-compressor (1932) gas-turbine sets for the Houdry catalytic cracking process, 1936.

The Houdry unit sets the pattern for the simple open-cycle gas turbine, Fig. 1. This has been adopted in several of the

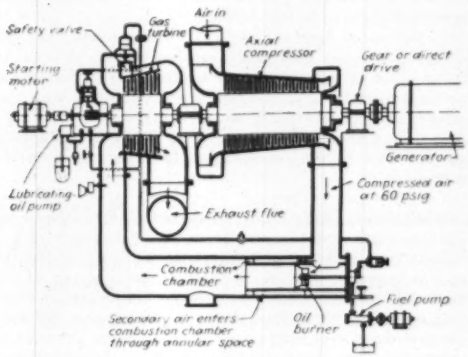

FIG. 1 SINGLE-SHAFT SINGLE-STAGE GAS TURBINE WITHOUT RECUPERATOR

commercial units built and merits continued interest for stand-by and peak-load installations. This unit is also applicable where low-cost fuel is available or where the supply of cooling water is a major problem. The simplicity of the plant, or the virtual absence of accessory or auxiliary devices results in low first cost combined with a satisfactory over-all efficiency that may well stand comparison with results obtained from other prime movers.

The next step toward higher efficiency was a single-shaft unit with air preheater or recuperator, Fig. 2. A number of commercial units with this arrangement have also been built.

These single-shaft with single-compression-stage units are somewhat limited in their capacity. The present range of seven available frame sizes is 1200 to 7000 kw, referred to generator terminals, with an ambient-air temperature of 68 F. By subdividing the air compressor into two machines and providing an intercooler between them, the capacity can be extended to 10,000 kw.

Several years ago the line of methodical development dictated going to two-shaft design, with two-stage compression (intercooler) combustion and expansion for capacities of 10,000 kw and higher. Here again the desirability of lower first cost resulted in an arrangement without recuperator, as shown in Fig. 3. One such unit has been built and has gone into peak-load operation.

For higher efficiencies required in base-load operation this cycle was expanded by the addition of a recuperator. At times a third compression stage, again with intercooler, was added, Fig. 4. Three units of 12,000, 13,000, and 27,000 kw capacity, respectively, have been installed and have been in operation for several years. While the terms of these contracts have been met, it must be admitted that the space requirements of accessory equipment (piping, heat exchangers, and the like) in these plants are quite large.

GAS TURBINE UNITS IN OPERATION

Table 1 shows the 13 gas-turbine units in operation at the end of July, 1951, arranged chronologically according to the year in which such commercial operation started. The tabulation shows also the type of fuel used, the over-all thermal efficiency at full load, referred to generator terminals (or including the driven machine, item 11) and based on the net heat content of the fuel, the total number of operating hours and kilo-

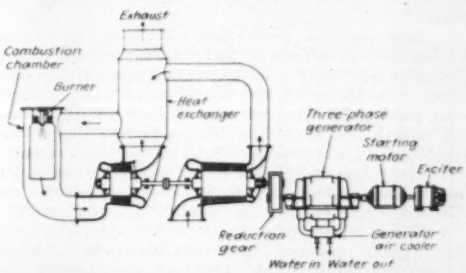

FIG. 2 SINGLE-SHAFT SINGLE-STAGE GAS TURBINE WITH RECUPERATOR

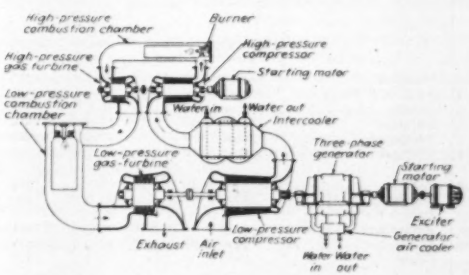

FIG. 3 TWO-SHAFT GAS TURBINE WITH TWO COMPRESSION STAGES AND INTERCOOLER

Contributed by the Gas Turbine Power Division and presented at the Annual Meeting, Atlantic City, N. J., November 25–30, 1951, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Condensed.

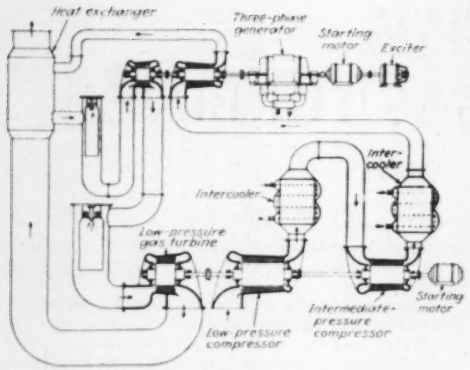

FIG. 4 TWO-SHAFT GAS TURBINE WITH THREE COMPRESSION STAGES, INTERCOOLERS, AND RECUPERATOR

watt-hours generated (or miles operated, items 2 and 10) up to July 31, 1951, and the corresponding cycle arrangement.

Operating experiences with these units have been as follows (item numbers refer to Table 1):

1 *Neuchatel, Switzerland.* This first commercial gas-turbine set, built for power production exclusively, was completed in 1939 and has since served as a stand-by and peak-load unit. It has only rarely been used for peak load, and was never called upon to perform its basic function—emergency service when overhead lines from hydroelectric plants were down. Thus its total operating time is rather modest but it is to be noted that no difficulties whatsoever were experienced during these years.

2 *Locomotive, Swiss Federal Railways.* While this set does not fall under the heading of "stationary gas turbines" it is of interest to note that this locomotive has been in regular train operation in Switzerland from the fall of 1941 to the spring of 1943, followed by a period of idleness, due to shortage of fuel oil, until the end of the war. During 1945–1946 it operated regularly in express passenger service on the French railways, 1947–1948 again in Switzerland, while in the summer and fall of 1950 it was loaned to the German Railways for extended test runs and to gain operating experience.

3, 9 *Beznau I (13,000 kw) and II (27,000 kw).* This installation was originally planned as a quick-relief measure for any serious shortages of winter energy. Operation was scheduled only during winter months with an anticipated operating time of 1200 to 1300 hr each season, depending of course on the availability of water power. The short distance between Beznau and the Baden shops, where the equipment was built, makes it possible to run tests and try out modifications while the units are not needed for power production.

As shown in Table 1, both units have accumulated substantial operating hours, the smaller set, item 3, roughly double the number of hours of the larger unit, simple because it went into operation one year earlier.

After extended operating periods the smaller set developed a number of difficulties, such as gas-turbine blading breakages, and the formation of hard crust deposits on the blades of the medium and high-pressure air compressors. However, the short distance from the factory permitted prompt investigation and rectification by various specialists.

4 *Chimbote, Peru.* This unit was ready for operation in November, 1949, but due to the small energy requirements in that locality—substantially below anticipated needs when the contract was let—the set is only in operation 10 to 12 hr per day with a load of 400 to 500 kw corresponding to 10 to 12 per cent of its rating. No difficulties or service interruptions of any kind have so far been encountered.

5 *Alexandria, Egypt.* This set, the smallest frame size developed for power production, supplies the energy requirements of an ice plant with only seasonal service during the spring and summer. Initial combustion difficulties with the extra-heavy fuel oil (specific weight 0.949, viscosity at 68 F, 5420 Cst) were overcome promptly by improved preheating and filtering. No other irregularities or indications of trouble were noted.

6, 7 *Pertigalete, Venezuela.* These two gas-turbine sets, each of 1650 kw normal rating, are the only source of power for a cement plant near Caracas. From initial start-up both gas turbines have been in regular operation without any disturbance or stoppage. One unit is adequate for supplying all the needs of the cement plant whereby they absorb regular overload swings of 1700 kw and short-time peaks up to 1800 kw. Temperature control equipment keeps the average temperature at the gas-turbine inlet at 1112 F. On Sundays the crushers and mills are shut down and work in the quarry stops. During this period the starting Diesel engine set takes over the remaining load of 200 to 250 kw.

Each gas turbine is operated for one month at a time. During the shutdown period the units are thoroughly inspected and, if necessary, the turbine and the recuperator are washed down, to remove deposits. Built-in washing devices make it possible to do this effortlessly in a short time.

8 *Lima, Peru.* This two-shaft unit with three compression stages has a nominal rating of 10,000 kw and will carry a maximum load of 12,000 kw. It was installed to supplement hydroelectric stations supplying Lima, during the dry seasons, usually from July to January. During this operating period, in 1950 and 1951, the set was in continuous operation with an average load of 9000 kw, except for a brief shutdown of a few hours every 4 or 5 weeks for checking the combustion chambers and recuperators. Since this plant uses a light fuel (Esso Diesel oil) there have been no ash problems in either combustion chambers or gas turbines and no parts of these elements show any wear or corrosive effect.

TABLE 1 GAS-TURBINE UNITS IN OPERATION

Item	Installation	Capacity, kw	Fuel	Efficiency (Gen. term., per cent)	Start of operation	Operating hours	Kwhr produced (in 1000 kwhr)	Cycle as per Fig.
1	Neuchatel	4000	oil	17.3	1940	1300	2350	1
2	Swiss Fed. Rwys.	1600	oil	18.0	1941	7000	300000[a]	2
3	Beznau	13000	oil	30.5	1948	5844	52681	4
4	Chimbote	4000	oil	19.5	1949	3325	1439	1
5	Alexandria	1200	oil	22.9	1949	4100	3400	2
6, 7	Pertigalete	1650	oil	25.0	1949	1, 7780 2, 6560	9295 7295	2
8	Lima	10/12000	oil	28.0	1949	6225	45876	4
9	Beznau	27000	oil	34.5	1949	3001	55838	4
10	British Rwys.	1840	oil	18.0	1950	1100	35000[a]	2
11	Baracaldo	2000	Bl. F. gas	25.0	1951	300	510[b]	5
12	Dudelange	5400	Bl. F. gas	21.5	1951	1000	5300	2
13	Filaret	10000	nat. gas	23.5	1951	250	1250	3

[a] Miles traveled in regular train service.
[b] Furnishes compressed air.

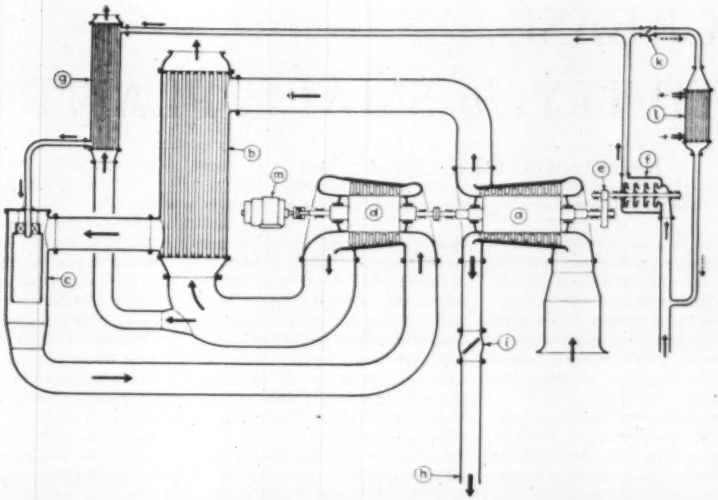

FIG. 5 GAS-TURBINE-DRIVEN CONVERTER BLOWER INSTALLED IN STEEL MILL IN BARACALDO, SPAIN

(*a*, Axial compressor; *b*, recuperator for air; *c*, combustion chamber; *d*, gas turbine; *e*, step-up gear; *f*, compressor for blast-furnace gas; *g*, recuperator for fuel gas; *h*, delivery air pipe to converters; *i*, stop valve; *k*, regulating valve; *l*, gas aftercooler; *m*, starting motor.)

10 *Locomotive, British Railways.* This 2500-hp locomotive was completely built in Switzerland and has been operating in regular express passenger service between London and Plymouth or Bristol since May, 1950.

11 *Baracaldo, Spain.* This gas-turbine set supplies air for a converter in a steel mill in an arrangement previously suggested also for blast furnaces. As shown in Fig. 5, the net output of this unit is taken out in the form of compressed air—26,500 cfm at 29 psig—representing a driving power of about 1600 kw. In the interest of simplicity, the air for the gas-turbine cycle is used at the same rather low pressure. The total air volume handled in the axial compressor is about 83,000 cfm, so that the useful air represents approximately 32 per cent of this total. This means that even large changes in the required air volume of the converter will affect only slightly the total air flow through the compressor. In case of sudden changes in the converter air any momentary surplus will be blown off to prevent pumping of the compressor.

Since the fuel—blast-furnace gas—is only available at atmospheric pressure it is compressed in a separate centrifugal blower, driven through gears from the main shaft, to the desired combustion pressure, about 65 psig.

Nothing unusual was reported during the operation so far.

12 *Dudelange, Luxemburg.* This gas-turbine generator set is installed in one of the main plants of the large Arbed Steel concern. Its arrangement is similar to the one shown in Fig. 2, except that a gear-driven axial compressor is added for compressing the blast-furnace gas fuel.

This unit went into regular service immediately after trial operations and has not given any indications of trouble. It is believed that this form of power generation in steel plants, where frequently there is a surplus of blast-furnace gas, will find many applications in the relatively near future.

13 *Filaret, Rumania.* This two-shaft unit, arranged according to Fig. 3, was completed several years ago after exhaustive tests were run at the factory with various grades of fuel oil. Because of political reasons it was only shipped and installed late in 1950 and has meanwhile completed several entirely successful trial runs.

Two other gas-turbine sets, each of 4000 kw, for operation with natural gas, have been completed and tested during 1950, for installation at the Tembi plant of the Anglo-Iranian Oil Co., Ltd., near Abadan, Iran. Erection of these sets was completed in June, 1951, but regular operation was delayed because of political complications growing out of the nationalization of these properties by the Iranian government. A third identical unit which was ordered after the successful shop tests of the first two sets and intended for the same company is nearing completion. These three sets are laid out for the simple cycle, Fig. 1, since the fuel gas has practically no market in that vicinity.

Together with the 5000-kw set under construction for the Pertigalete cement plant in Venezuela—also for natural gas fuel—the total number of commercial gas turbines in operation, erected, or nearing completion is 17.

SUMMARY AND OUTLOOK

Reliable and trouble-free gas-turbine installations are now a reality and may be adopted without any qualification where gaseous fuels are available. While natural gas holds a particularly prominent position in many parts of this country, also leaner gases, especially blast-furnace gas, offer interesting possibilities in the vicinity of steel mills where, incidentally, cooling-water volume and quality are often real problems. Fuel oil as stand-by is quite acceptable in most industrial plants.

Heavy fuel oils may be used with certain restrictions as to quantity and composition of ash content and for plants allowing periodical short shutdowns for cleaning. When these restrictions are observed, reliable long-time service will also be obtained from oil-fired plants.

Outages for other maintenance work—or for all maintenance and servicing in the case of gas-fired units—will be of the same order as for modern steam-turbine plants, namely, insignificant. Also the useful life of the equipment should be no shorter than is expected of steam-turbine installations.

The major field of application for the next few years will no doubt be in small and medium-sized units. This discussion has shown that fully developed and tried-out designs in single-shaft arrangement are available in the range from 1200 to 10,000 kw nominal rating in a total of eight standard sizes, for power generation or mechanical drives.

The larger and more complicated unit sizes in two-shaft arrangements, while fully as reliable as smaller units, are somewhat handicapped by the high cost of the additional heat exchangers and connecting piping. Their broad use may well await further development in metallurgy and fuel chemistry, permitting advances into higher-operating temperatures without the present hazards.

How to INCREASE PRODUCTIVITY *in* SMALL PLANTS

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INCREASED productivity is the most important mission of plant management. On industrial productivity will depend our standard of living, the wage, price, and employment level, the length of the work-week, and now perhaps national survival. On small-plant productivity will depend the ability of the small concern to compete, to prosper, and to survive. It will determine the extent to which the industrial base of military procurement can be broadened to include the small plant in defense mobilization.

Constructive thought on the problem of increasing productivity requires a broader concept than the usual one of output per man-hour. This concept should reflect not only the effective use of manpower but also the use of buildings, equipment, materials—every dollar invested and expended. In these terms, productivity is the measure of management competence. No single index expresses it—it is a composite of output per man-hour, per machine, per capital dollar, per expense dollar.

Let us also broaden our thinking on the causes of low productivity. Restricted thinking which regards productivity as strictly a plant-management problem fails to recognize that in the small concern weakness in the nonmanufacturing functions—sales, credit, finance, procurement, personnel—are as likely to be the basic causes of low productivity as shortcomings in the production function.

To us in the West, the common definition of a small plant as one with less than 250 or 500 employees is absurd. We think of the small plant as a much smaller organization, one with less than about 50 employees. This includes more than 80 per cent of the manufacturing plants in the country. The management problems which such a company must face and the functions which must be performed are basically not much different from those of the big company. But there is one fundamental difference—the job must be done without the luxury of staff assistance. In this fact lies the real problem of increasing productivity in the small plant.

The problem falls naturally into areas of manpower, plant and equipment, and management.

MANPOWER

First consider manpower—the selection, training, and motivation of personnel. In the worker lies perhaps the greatest and at the same time the most intangible potential for increasing productivity. The success or failure of equipment, methods, or management techniques to a large extent will be dependent upon his co-operation or resistance. Most small plants have difficulty in retaining their better workers, and the costs of labor turnover, in terms of selection, training, spoilage, extra supervision, and production interruptions, are likely to be more serious than in larger concerns.

Selection. The worker without aptitude or skills is not productive. In the small plant, which must depend so largely upon flexibility and ingenuity, proper selection of workers is as important as proper selection of location, materials, or equipment. In most small plants the selection process is haphazard. Very few have developed job specifications. Most conduct an informal interview, but with only a general concept of what to look for. Some ask for recommendations from former employers; a few give simple dexterity tests; most have tryout or probation periods. Some broaden their choice by advertising; some ask their employees to recommend others; some take what wanders in the door.

The author makes no general recommendations for improving the selection process. Emphasis is placed on the fact that selection offers an opportunity because, for the most part, it is so carelessly done. Obviously, no small plant can afford the elaborate selection techniques of the more advanced larger concerns. But likewise, few small plants can afford the high cost of misfits and excessive turnover. A realization of these costs should make for more careful selection and may point the way to a simple, practical solution. In most cases, selection is so important that it should be handled by the owner-manager himself.

Training. The need for training in the small plant starts at the top. In most cases, the success of the company will depend more on the management competence of the owner-manager than on any other single factor. In many ways he has a more difficult job than the large-company executive. He typically has had experience or training in only one or two of the functional fields of management and cannot afford to hire trained staff experts to fill his gaps, or share his load. This is a special problem, and more can be said on it later, but it should be stated at this point that in most small plants the first training problem is that of training the boss.

Like the manager, the foreman in the small plant will have extra responsibilities which in a larger plant would be handled by staff people. Productivity in the small plant inevitably is dependent upon the foreman's technical competence, versatility, ingenuity, and ability to lead, to instruct, and to organize and plan his work. The company with two or three foremen cannot justify a formal training program, but it can use supervisory round-tables, adult training courses in nearby schools, reading programs, visits to other plants, and membership in foremen's organizations to develop its supervisory staff.

In the same manner, the need for effective worker training is greater in the small plant than in the large plant for, typically, workers must be more versatile and more flexible. In most small plants workers learn their jobs "the hard way," through casual, unplanned, and uninspired instruction or through "exposure" alone. There are few areas which return so much for so little as effective training. Again, no formal program is suggested. But job requirements should be analyzed carefully, a simple control chart listing skills, deficiencies, and progress of each worker can be set up, and responsibility can be clearly assigned either to foremen or to one person trained in training.

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Motivation. Motivation, or stimulating the desire to produce, is the most intangible and most frustrating aspect of this problem. Yet no one can deny that a man's production is determined largely by how he feels about his job, his company, his fellow workers, and his boss.

The potential here is impossible to measure quantitatively. Certainly in many cases it is well over 100 per cent. Perhaps the opportunity is not as great as in the large concern, for the small plant has certain natural advantages. Even the most obscure worker can see his significance in the company's operation. There is usually more variety in his work, less monotonous routine. Changes initiated by management have more meaning to the worker and probably meet with less resistance. The owner is closer to the problems of the workers; his personality can have a more direct effect on the shop morale; it is easier to develop personal loyalty between the workers and management.

These advantages reduce but do not eliminate the opportunities for improvement. If the manager's personality has a more direct impact on shop morale, then it can work for bad as well as good. The small shop does not offer the security of the large concern. Temporary layoffs are likely to be more frequent, particularly in the job shop. Physical working conditions are usually not as good, and employee benefit programs are necessarily more limited. The competent small-plant manager recognizes his workers as individuals, illogical and largely unpredictable, but absolutely essential to his success. Common sense, fairness, sincerity, respect, and a conscientious effort to understand the worker's viewpoint and to stabilize the work load can pay large dividends.

What about wage incentives as a means of attracting, keeping and motivating good workers? There have been dismal failures as well as outstanding successes. Certainly they are no panacea. They are not substitutes for competent management. In fact, if wage incentives are to be successful they may require outstanding production control, supervision, methods, training, quality control, maintenance, and working conditions. If the company has done an effective job in these areas and has promoted loyalty and morale in other ways, there may be little that incentives can add.

The use of individual incentives in the small company involves special problems—the cost of developing sound performance standards, measuring output at each operation, and computing payrolls is likely to be high. Many small shops operate on a job-shop basis, which does not lend itself to incentive payment. A group bonus, perhaps based on labor cost as a percentage of sales, is likely to be more effective and at the same time less costly than individual incentives for the small plant. Profit sharing may be effective in stimulating the small group responsible for management decisions.

PLANT AND EQUIPMENT

Although one occasionally finds a small plant with the best of buildings and equipment, it is much more common to see them hampered by crowded dingy work space and antiquated machinery. Many small concerns work under space handicaps that make safe and efficient operation, proper layout, inexpensive materials handling, and good shop housekeeping almost impossible. This problem is one for individual solution, and no general recommendation can be made. But the wastes of inadequate space and equipment are great and must be recognized.

A small plant visited recently is typical of too many other small shops: In the foundry, large quantities of facing sand were being riddled by hand. All sand was moved by shovel or wheelbarrow. Patterns were stored on the open floor because adequate protected storage space was not provided. It was not until last year that a skip was built to charge the cupola—for fifty years scrap and coke had been rolled up a long wooden ramp in a wheelbarrow or hoisted on a small rope elevator!

Some of the equipment in the machine shop had been bought secondhand as long ago as 1901. Less than 25 per cent was purchased in the past 20 years. The operator of one of the large lathes reported that his machine could hold tolerances of $^1/_{32}$ in.—"if you're close to the headstock." Until a new heating system was installed last winter, machinists kept warm around drums filled with live coals. The floor was cluttered with bar stock, tools, air hose, change gears, work in process, and scrap.

In the fabricating shop three men were doing work on a nibbler that could have been handled in a fourth of the time by one man on a squaring shear. Angle iron was bent by torch and sledge hammer. Because management would not invest in a pantograph burner, duplicate contours are individually flame-cut day after day from heavy plate, then ground to final dimension.

The result of all this is such low productivity that the company cannot compete in normal times, can barely make a profit in boom times. Its alternatives now are liquidation or complete re-equipment, at a cost equal to its entire working capital. The money which has been wasted in maintaining, rebuilding, and operating this "junk" could have replaced most of it several times over. This situation did not arise from lack of funds—it was the result of overconservative unimaginative management.

A machinist in another plant displayed with pride a rose reamer he made as an apprentice 40 years ago and is still using regularly on production work—sawed out of carbon steel with a hack saw!

Machine-tool dealers state that most of their used machinery is sold to small plants. It should be remembered that used equipment usually gets on the market because someone finds he cannot afford to keep on using it. A dealer recently showed the writer a homemade turret lathe, the bed welded up of planed and ground railroad rails. It was a beautiful tribute to the maker's ingenuity, craftsmanship, and above all, his patience. But it did little credit to his understanding of shop costs! The dealer confidently predicts that it will be sold—to a small plant.

Even plants progressive in other respects often economize by purchasing equipment too small or too light for their needs. Two years ago a small western machine shop, to save a few hundred dollars, purchased a 1-hp air compressor rather than the 5-hp unit they knew they should have. This year they finally replaced it with the 5-hp machine. In the meantime the compressor has run almost continuously, operations have been constantly hampered by lack of air, and several times a day the company has had to shut down a $9000 turret lathe, which has an air chuck and feed, to keep the air vises on its production mill functioning properly. The same company economized by buying only one set of cutters for a milling job and periodically has to shut the mill down for an entire shift while the cutters are sent out for grinding. A broken cutter would cause a shutdown of several days. In all probability the job will be extended and another set of cutters purchased, but the company still cannot see its way clear to tying up the money in another set until it actually is needed. "Our cash is limited," they argue, "and there are other places the money can do us more good."

Perhaps discussion of this subject is academic at a time when new tools are difficult to obtain. Nevertheless, antiquated or overloaded equipment inevitably leads to high labor costs, inefficient production, breakdowns, and spoilage. Usually

new and adequate tools cost little more. And there are other alternatives. Work can be farmed out to others who are better equipped. Properly rebuilt machines of recent vintage are sometimes available. Machine tools often can be leased, and there are special advantages to the small plant in such an arrangement. Where the ideal tool is not available, general-purpose equipment sometimes can be converted to high production. One small company during the last war repeatedly underbid larger concerns on turret-lathe work even though it had only a group of small engine lathes. But it had fast-acting face collets, ingenious tooling, good machine layout, efficient materials handling, and clever job breakdown.

There is a real challenge here for the machine-tool industry—in developing inexpensive, versatile, and yet highly productive equipment, intermediate between the basic general-purpose tool and the single-purpose high-volume automatic machine. New thinking in this field already promises economical equipment ideally suited to the needs of the small manufacturer.

Probably there is no more certain way to increase productivity than through good tooling. Clever and imaginative jigs and fixtures can go a long way in transforming the general-purpose machine tools of the small shop into efficient, high-production equipment. They can enable old machines to produce to close tolerances. They can reduce fatigue, operation time, and operator-skill requirements. Tooling for the small plant need not be elaborate or expensive, and simple jigs and fixtures can pay their way even on short-run production.

There are two related areas where the opportunities are also great, namely, substitution of powered equipment for the hundreds of jobs still performed by hand, such as driving screws and nuts, hammering, bending, materials handling, and so forth; and provision of air or hydraulic vises, traverses, and feeds. Too few small plants seem to realize that horsepower is almost always cheaper than manpower.

MANAGEMENT

The third opportunity for increasing small-plant productivity lies in good management—the administration and control of manpower, plant, equipment, materials, and operations. Most small-plant failures can be attributed to a lack of managerial ability. Usually one or more management functions loom as offering the greatest opportunity for increased productivity.

Nonmanufacturing Functions. There is a tendency to regard productivity as strictly a plant-management problem. Yet the greatest opportunities may be outside the manufacturing field. Most small-plant owner-managers have had their training and experience in only one or two areas of management. Few have competence in all. The common result is a lack of management "balance," lack of perspective, overemphasis on certain functions at the expense of others, failure to think objectively in terms of the entire operation.

Neglect or incompetence in nonmanufacturing functions, such as finance, can have as great an effect on productivity as shortcomings in production. Limited capital is the main deterrent to the installation of modern equipment. It leads to retention of outdated machines, to purchase of equipment inadequate for the job, and to other false economies. It shortens manufacturing runs. It increases materials costs by forcing purchase in uneconomic quantities. It is a deterrent to improvement of product design, to research, to innovations of all kinds. There is no cure-all for this ailment. Perhaps the solution is additional capital. More likely, it is better use of existing funds—stores control to get best use of the inventory dollar, production control to minimize work-in-process, sale of excess facilities, proper equipment maintenance to conserve fixed capital.

Perhaps the problem is one of credit. A small foundry, pressed for capital recently, found its average turnover of accounts receivable was 90 days, while the average for its industry was 35 days. In a period of three weeks, through action to speed payments, it added substantially to its available working capital. It raised additional cash by liquidation of excess-metals inventory, some of which had been on hand for more than five years.

This same foundry's sales volume dropped in the last few years to about half of what the shop could produce. The company retained all its personnel in spite of the decline. In such a situation it was academic to talk of increasing productivity through better equipment, improved methods, or motivating workers. None of the plant-management functions had much meaning until the sales function was fulfilled properly. At the same time, until the credit job was better done, increased sales would have tied up even more working capital in accounts receivable and released none to productive use.

On the other hand, overemphasis on nonmanufacturing functions also can injure productivity. Penny-pinching purchasing can cripple the shop with shoddy materials and production interruptions. Product design which overemphasizes salability may sacrifice producibility. In many lines, failure to take action to minimize seasonal fluctuations will subject the shop to extreme highs and lows, neither conducive to high productivity.

A small western company sells through several different types of distributors and has added to its product line virtually any new item which conceivably might be sold through these same channels. The objective is to spread its sales overhead, but the result is a shop which looks like a three-ring circus, with everything from plastic kitchen gadgets and stationery supplies to brass door jambs and heavy steel motor mounts in process. Specialization and concentration in the line you know best yields highest productivity. There is a lesson here for plants which in their rush to obtain defense work take on jobs ill suited to their equipment, skills, and management know-how.

Organization. The typical small-plant manager is the most overworked man in the world. He complains with reason that he hasn't time for advance planning, hasn't time to visit other plants or professional meetings or to discuss his problems with others, hasn't time to sit back and consider his operation objectively, can't afford proper attention to the many necessary nonmanufacturing management functions, can't keep up with current technical, economic, governmental, and management developments. Part of the difficulty is failure to plan ahead and to utilize his time properly. But, typically, he also fails to share his load with others, fails to delegate his routine day-to-day responsibilities and those for which he has no time, talent, training, or experience. If he does assign responsibilities to others he may do so with misgivings, retaining all real authority himself so that his subordinates cannot adequately assume or fulfill their responsibilities. As a result, he continues to be swamped by petty decisions of little consequence.

The typical small plant is too complex for efficient operation by one man. He must divide the job logically and assign the functions clearly and without gap or overlap or confusion. He must stimulate and develop in his subordinates the ability to carry these responsibilities and he must somehow develop means of control and of assuring competent performance. Thus he can relieve himself for the broader, more important problems for which he claims he has no time, the problems which he alone should handle. Thus, in effect, he can increase his own personal productivity. The excuse that it is more trouble to get someone else to do the job than to do it himself is only an admission of inability to manage.

Most small plants cannot afford the line-and-staff organiza-

tion of larger concerns. But even the very small plant can afford a girl to keep purchase, stores, equipment, production and personnel records, the "hack" data too many managers either try to maintain themselves or forego altogether. Some could well afford a small, versatile staff organization. In most cases, such functions as planning and controlling the flow of work, controlling costs and quality, maintaining equipment, improving processes and methods, must and should be borne by regular line personnel—the plant superintendent, foreman, lead hands, and line workers themselves. Assignment of such functions to line people gets the work done at minimum cost, enables them to perform their primary line functions more effectively, and develops their capacity for greater management responsibilities. Development of subordinates is a primary responsibility of any executive, perhaps more important in the small plant than in the large concern. An effective tool of development and management, readily adapted to small-plant operations, is a productivity committee, in which all supervisory personnel meet regularly to consider plant operating problems.

Plants of 30–50 employees might well afford a one-man staff, a jack-of-all-trades, a "manufacturing controller," to handle production control, quality control, cost control, stores control, and other plant-management functions to the extent that they cannot be delegated readily to the line. If he has general business experience or training he could also assist in the non-manufacturing areas, where so many small-plant managers are weakest. Every year our business schools and some of our engineering schools turn out hundreds of men qualified for this assignment and anxious to work in small business. Yet few such opportunities are open to them.

Production Control. With equipment and manpower increasingly difficult to obtain, production control takes on added importance. It is essential to machine and worker productivity and to realizing the most from available facilities. Plants stepping up from job-shop to continuous defense production will face new problems in planning, scheduling, and controlling the flow of production unlike any they ever have had before.

Advance planning is probably the most important function of good management, yet many small plants have no planning and no control beyond that which the manager carries in his head or in an envelope in his hip pocket, or on a calendar on his desk. Many plants, particularly job shops, are convinced they cannot plan, and have given up trying to. As a result, workers and machines are intermittently idle for lack of materials or tooling or job assignment. Bottlenecks are handled on an emergency basis as they arise. Capital lies idle in materials bought long before they are needed or is wasted buying materials too late on an emergency basis. Space and working capital, both so important to the small firm, are tied up in half-finished work in process while missing parts are found or completed. Operations are performed in wasteful sequence and machines torn down in the middle of production runs to make way for higher-priority orders. Delivery dates are broken and customers lost. Costly expediting and trouble shooting substitute for orderly control.

Production control for the small plant need be neither complex nor expensive to be effective. The question is not whether the small plant can afford orderly production control—it is a question of whether it can afford to be without it. For who can estimate the costs of expediting, of interrupting production runs, of delayed deliveries, of lost customers, of cluttering up the plant with excess materials and work in process, of confusion and poor morale? Whether you can evaluate these costs or not, it is perfectly obvious that no company, large or small, can afford to ignore them.

Process and Methods Improvement. In a period of great technological change in processes and materials—powder metallurgy, new foundry techniques, new forming methods, hot-machining, new fastening and joining techniques, printed circuits, light metals, new adhesives, synthetic fibers, ceramics—complacency is inexcusable and may be disastrous. No small plant can risk the handicap of outmoded processes, materials, or designs. The sources of information are many, and in most cases data are available at little or no cost from trade magazines, suppliers, customers, or equipment manufacturers.

Improvement in production methods may offer even greater opportunities than new materials or processes. Simple inexpensive changes in motions, in sequence, in tooling, in workplace layout can accomplish spectacular savings; and every job, direct and indirect, office and shop, offers opportunities. It doesn't take an industrial engineer to improve methods. The techniques are simple and readily applied by regular line personnel. The foreman or shopworker, if given the training, encouragement, and incentive to improve a job he knows from daily experience, in many ways is in a better position to improve methods than the outside engineer. His potential contribution may be limited to the less complex, nontechnical operations, and the methods he develops may not be so refined as those developed by the engineer. But they will be obtained at virtually no cost, are likely to be practical and will be accepted more readily at the shop level. The JMT courses developed during the war are ideally suited to the needs of small plants.

Cost Control. Cost control is a measuring stick which can be used in pointing out opportunities for improvement, setting performance goals, and measuring productive efficiency. Many small plants lack any real knowledge of their costs. The company accountant is the logical person to develop a control system and to train the owner-manager to understand and appraise cost data. The actual operation of the system should be an internal affair, and control over many specific costs can be delegated directly to foremen or others. Waste-control programs should be participated in by everyone. Cost-reduction committees can be highly productive and help stimulate cost consciousness throughout the plant.

Quality Control. Productivity is measured only in terms of units which meet specifications. Spoilage is pure waste. Inspection is not quality control. The function of quality control is to stimulate acceptable production, not merely to detect rejects. This requires explicit standards, clear assignment of responsibility, watching trends, spotting defective work before further labor and overhead are wasted or other pieces ruined, uncovering and eliminating causes of spoilage.

Tolerances in the current defense program are for the most part much tighter than in the last war. It is true in the West and it must be true elsewhere that many small plants, some of which produced successfully during the war, have been unable to share in the current mobilization program simply because they cannot economically hold the tolerances required. Prime contractors hesitate to subcontract to small plants, and some report entire shipments rejected for failure to meet specifications.

Again the question arises as to how much control the small plant can afford. Spoilage means a loss of materials, man-hours, and productive capacity as costly for the small plant as for the large plant. One, with only 10 shop employees, profitably employs a full-time roving inspector. But the important aspect of quality control is not the amount of inspection, it is the emphasis; emphasis on making the part right in the first place, rather than on inspection to detect spoilage. As volumes expand, new and more elaborate quality-control

techniques will become feasible as old techniques become inadequate.

Miscellaneous. The functions discussed in the foregoing do not necessarily offer the best opportunities for increasing productivity. In any given situation the greatest potential may lie in some other area—*materials handling*, for example. Materials handling typically accounts for $\frac{1}{4}$ to $\frac{1}{3}$ of the labor bill. Handling is waste; it adds nothing to the value of the product. Small plants are particularly deficient in this area. The greatest opportunities will lie in decreasing the number of times the work is handled, improving the methods by which it is handled, and shortening distances. No plant is "too small" to devote serious attention to the way it handles its materials.

The best opportunity may lie in improving *production standards*, as a basis for budgeting, cost control, estimating, planning and scheduling, incentives, or evaluating performance. Some small plants have no standards at all. Most will have only occasional use for stop-watch time study, but can do better than the guesswork commonly used. Standards based on recorded experience and judgment, in spite of their disadvantages, appear to be the most practical solution in most situations. Many will find synthetic or elemental time standards well adapted to their needs.

Good *plant housekeeping* also offers an opportunity. Most small plants are "string savers." Aisles, work areas, and space under benches and behind machines are often cluttered with supplies, raw material, scrap, work in process, machine parts, tools, and miscellaneous junk. Poor housekeeping leads to low morale, careless maintenance, accidents, and lost or damaged product. The cost of orderliness is negligible and the benefits are substantial.

There are further opportunities—in preventive maintenance, in safety, in tools control or stores control. It might be said that keeping records offers an opportunity for increasing productivity. The success of almost all the control functions discussed will depend upon well-maintained records. Many small-plant operators avoid any paper work which does not immediately and directly increase profits. Growing enterprises often fail to realize that the informal personal controls which worked in the 5-man shop may not be suited to the operation of a 50-man shop. The problem is not one of how to do without paper work; it is one of determining what is needed, how to organize for it, and how to do it most effectively and most economically.

Outside Influences. This problem has been examined from the standpoint of what the small-plant owner-manager can do to increase productivity. The influence of outside groups also deserves consideration.

Governmental agencies talk at length about improving the competitive position of small business, yet much legislation actually serves to penalize the small plant. Recent taxation has drained off working capital which might have gone into longer production runs or into more productive facilities, has reduced the flow of new capital to growing enterprises, has reduced the incentive to improve operations, and has forced the small-plant owner-manager to devote additional time to nonproductive activities.

Current materials regulations, emergency controls, and procurement procedures are confusing, time-consuming, and potentially disastrous for many small plants. Most small concerns are not in a position to bid on large government contracts, and many have not yet been able to obtain subcontracts. Some prime contractors appear to have adopted a policy of subcontracting major subassemblies to a few large plants instead of subcontracting parts to small producers. Eventually, defense work may overflow to smaller concerns, but meanwhile many of them are finding their volume curtailed by materials shortages and their labor attracted to larger plants. Today the small-plant manager can devote even less time to the actual operation of his business and must spend more and more on studying regulations, chasing subcontracts, developing bids, obtaining a CMP allocation, and, after he obtains his allocation, to finding materials. When he gets the materials, he may find he cannot buy motors, ball bearings, or other critical parts. It is little wonder that a number of small plants are cutting back to minimum operations in bewilderment and disgust.

Even if he gets a subcontract, life is little easier for the small-plant operator. This is typical of current complaints: "We are busier than ever, and we work longer hours but we are not making money. We spend half our time on forms, regulations, bids, and other nonproductive activities. Competition for subcontracts is keen, and we can never get allowances adequate to cover our tooling and 'start-up' costs. Every job or change order brings new problems to be worked out, whereas our peacetime product was pretty well 'debugged.' Specifications are vague, the prints are new to our people and tolerances are unreasonably tight. We have no recourse because the customers' engineers will never admit they have overdesigned. If we have a contract for 5000 items, we probably will be allowed to deliver only a couple of hundred a week, perhaps a day's run. You can see what that does to costs and productivity!"

There are many sources of outside technical and management assistance for the small plant—suppliers, customers, local schools, universities, consultants, chambers of commerce, and state and federal governments. These agencies often can provide assistance of real value, although it must be admitted that in too many cases such service is either nonexistent, or the advice superficial, incompetent or poorly adapted to the problems at hand.

Unfortunately, most small-plant operators are reluctant to seek or accept outside help. Few take advantage of the opportunities available to them. Understandably, the individual who has made a success of his business may well resent the suggestion that outsiders could give him advice on how to run it. At the same time, he may fail to grow organizationally to provide the necessary management talent and control from within.

The failure of small business to utilize the assistance already offered poses a serious problem. It emphasizes the importance of improving the quality of the assistance, of doing even more to help the small-plant operator to help himself. In those few communities where really worth-while assistance has been provided, small businesses appear to have accepted it readily, with benefit to themselves and to the community. The possibilities in local clinics, staffed by active and retired businessmen, have hardly been scratched. Such a body could make a very great contribution, not in meeting the day-to-day problems of running the plant, but in bringing sound experienced judgment to bear on the broader management problems.

In the last analysis, it is the small-plant manager himself who can do most to increase productivity. He has the real motive, the prime responsibility, the great opportunity. But his reluctance to accept outside assistance emphasizes the educational job to be done by others in dramatizing and advertising the opportunities for improving small-plant managerial competence and increasing productivity. If the prosperity of small business is truly essential to our economy, if the productive capacity of small plants is essential to national defense, then those who can point the way to increasing small-plant productivity clearly have an obligation to do so.

CONSERVATION *of* MANPOWER *and* MATERIALS

By H. H. ANDERSON

VICE-PRESIDENT, SHELL PIPE LINE CORPORATION, HOUSTON, TEXAS. MEMBER ASME

IN the oil industry as in every other, opportunities exist for conserving manpower and materials. How to classify them, however, is not so easy.

Let's first define our objective. The best definition I can find of "conserve" is "to preserve from waste or loss." Thus to preserve from waste, we must minimize manpower inefficiency and wastage of materials in work accomplishment. To preserve from loss, we should eliminate unproductive work where the expenditure of manpower and materials, however efficient, is fruitless. In today's emergency, all manpower and materials so conserved should find immediate, productive, and more profitable placement within our own expanding demands for new essential work.

Since my audience this evening is made up largely of managers and engineers in the oil industry, certain of these opportunities will be illustrated with examples selected from that industry. However, nearly all of the opportunities are present in one form or another in most mechanically based industries.

Let us first consider opportunities for such savings open to the manager, then list some open to the engineer, and finally consider how we can save "engineer-power."

Do you ask, "Why should engineers interest themselves with management problems?" Technical ability alone will not suffice the ambitious engineer. To control the forces and materials of nature, he must be able also to direct the human effort required for such control. He need not be able to finance his projects, but he should be able to justify them costwise. Industrial management involves co-ordination of men, materials, and money. Thus, at least in the oil business, successful engineers are managers at heart.

The engineer properly works for technical or mechanical advance. The manager also must advance the co-operation of rank and file to achieve results. One management problem is to get the engineer to relate his effort to the over-all objective. Conservation depends as much upon betterment of attitude and method as it does upon mechanical improvement. Thus the engineer serves conservation best when he thinks in terms of practical supervision as well as technology.

WHAT MANAGERS CAN DO

What can managers do to conserve manpower and materials?

Improve Employee Morale. Where possible, the prime thing is to improve employee morale. This requires constant study of —and improvement in—salary, wages and benefit plans, office and plant conditions, supervisor attitudes, delegations of responsibility and authority, and other things affecting morale. Employee morale is a state of mind or attitude. More than any other thing, high morale will impel each worker to increase his work output, and to reduce his waste of materials and supplies.

Promote Safety. Next is promotion of safety. The most loyal work force may be accident-prone unless safety is always stressed. Safety is "out of sight and out of mind." But when loyal workers are made safety-conscious, they abhor and avoid the absenteeism, and the breakage and spoilage of equipment and materials, that attend accidents.

Start Improvement at Top Level. The morale of employees stems from and reflects the attitude of the top executives. Thus improvement must start with the top, after which it can be spread down through the chain of command to the front-line foremen. If top management adopts fair employee policies, and if it trains the supervisors at all levels in their sympathetic execution, the attitudes of the rank and file will improve. Then they will work harder and waste less. Where such a program goes sour or doesn't click in one segment, the trouble may be in the local supervisor's attitude.

Encourage Employee Suggestions. Loyal employees yearn to help the company to succeed. Perhaps overrated as often as maligned is the employees' "suggestion-box" plan for stimulating and collecting their ideas. But, where this formal plan is not in vogue, managers should carefully provide other channels through which such suggestions will be voiced, considered, and put into use if good. Simple ideas can lead to much conservation. In fact, the opportunities for conservation are often best seen on the scene!

Cut Red Tape. Niagaras of time, energy, and ambition may be salvaged by cutting internal red tape. Flagrant is the narrow-minded chief who must straddle everything, even requiring the simplest contact to be made in his name. Most juniors can be trusted to use good sense in their job routine, and to refer policy questions to the supervisor, when dealing directly with other sections, departments, or divisions, or with suppliers and customers. Thus routine contacts should be encouraged at the lowest rank consistent with policy control.

Discourage Nonconformance. Larger departments may have several division offices. All may have similar objectives that can be accomplished under common policies. But among them are local chiefs and section heads who will recognize common denominators, while others are blind to all but the differences in their problems. The conformers work amenably under the common policies, but the dissenters contend (and constantly) that everything must be tailor-made to serve peculiar needs. Here changes in division heads may conserve the senior planning time and energy lost in such contention.

Co-Ordinate Policy Planning. Planning time also can be wasted by the home-office heads. Suppose they are keeping plans for new projects, procedures, or policies under wraps. The need may have been seen also in several of the divisions, with resultant duplication of effort. Either the liaison between offices is poor, or their common problems are not widely and frankly enough discussed. Time wasted by a foreman may affect only the scope of his crew, but the time wasted in the planning offices can affect adversely a dozen foremen and their crews, if not the whole organization.

Review Manpower Needs Periodically. Crews and work equipment always build up as scope of work increases. But when the work levels out or declines, supervisors may neglect or

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are reluctant to lay off or transfer unneeded men conformably. Then each worker reduces his productivity, or crews "make" work to keep occupied. Regularized reviews of work force versus needs will indicate warranted force reductions. This goes as well for the clerical and engineering staffs.

Don't Neglect Recruitment. Our zeal to save manpower should not cause us to neglect recruitment of qualified youngsters for our staffs. Most companies are shorthanded at best with additional work demands arising daily; and all are shortsighted if they neglect the continued training of replacements for senior technical and executive staff. Immediate use can be made of recruits to relieve more experienced men of essential routine, and thus allow them to spend additional time in planning and directing.

Reduce Field Reports. The contingent losses from needless or poorly planned "paper work" are many. Floods of reports are demanded from the plant and field. The bulk of these are on forms to be prepared by foremen who have little skill as amanuenses. Some foremen more appropriately could be called "form-men." These many forms should be reviewed constantly for need and context, and thrown out or simplified to the limit. Then each foreman can give more attention to his prime duty of job planning and direction to increase productivity and reduce waste.

Improve Cost Statements. Reams of statements are issued by our accountants. Their intended—if not actual—use is to assist management to increase revenues and to control costs. They can serve this high purpose only when they disclose controllable elements. Department managers may want to see costs segregated to show who is responsible. But superintendents can more effectively control costs with statements that show what is responsible, such as labor, materials, vehicles, power, and fuel. Better planning of all cost statements will improve the tools for cost control and conservation.

Review Equipment Needs Periodically. Also, as field production declines, periodical review will disclose equipment units that no longer are needed, or may be replaced by much smaller units. Today, especially, we should search for hard-to-get large-capacity items—such as tanks, pumps, and the like—now working at low use factors, that may be replaced by small units which can do the job by operating longer hours if necessary. The smaller equipment with increased use factors will save money and, with the smaller pumps, the reduced pressures will conserve line maintenance.

Contract Construction. What about contracting work? The most efficient use of men and tools occurs when the force is stabilized to optimum size. This can best be done when work is limited to daily recurring tasks. Most operating companies recognize this by contracting major construction, and some now contract many minor jobs. If the smaller contractors can obtain enough such jobs from several operators, they too can stabilize their forces.

Contract Maintenance. Operators usually keep a few mechanics and small crews on hand for emergency repair or maintenance; and they strive to keep these meanwhile employed. As with construction, when larger or unusual maintenance jobs arise, they may avoid building up the force by contracting the work. But the smaller maintenance jobs—if intermittent—also lend themselves to contract for over-all conservation.

Use Blanket Contracts. The contracting of smaller jobs of construction as well as maintenance can be simplified—yet kept competitive—by use of two or more open or "blanket" agreements with local contractors. These may set out all contractural conditions and job specifications, but leave the unit prices to be bid in each desired case. The laying of short lines, tank cleaning, painting, and even well-pulling, can be so handled to good advantage.

Don't Overdefer Maintenance. Our zeal to conserve should not cause us to postpone protective maintenance unduly. If industry is reduced to privation, there may be no choice. But we can ill afford to chance complete renewal of vital plant through such deliberate delay. Critical losses of plant outturn would occur during the renewal period; and our conservation program would boomerang! Here is a real dilemma, however, because present high tax rates urge us to do maintenance that can be postponed safely. This, too, frustrates conservation!

Don't Overconserve Capital. With less and less net profit retention in sight, our appraisal of capital projects is distorted. Given any choice, management tends to reduce today's capital outlay by increasing tomorrow's operating and maintenance expense. This expedient should be applied with care if we are to remain in business. Even in normal times, too much capital penny pinching can create an incubus for posterity. If conservation is our aim, each new project alternative should be appraised with the future as well as the immediate use of men and materials in mind.

Use Laborsaving Equipment. Much manpower can be saved by use of more modern work equipment and tools. Addressographs and calculators, or bulldozers and airplanes may be in short supply at this time. But each is designed to speed up work, to reduce errors, and to conserve muscles and supplies. Consider the pipe-line air patrol. One pilot with a tiny plane can do a job that used to require 30 to 40 line walkers.

Use Automatic Devices. Other manpower can be saved—and other benefits be gained—by use of automatic protective devices. For example, in some pump stations these can reduce attendance by 75 per cent. Again, automatic tank shutoffs and air bleeders in field gathering lines will reduce labor, reduce internal corrosion, and increase line flow. Also, they may permit removal of several pumps and engines for other uses.

Encourage Corrosion Control. Most oil-industry equipment is metallic and is subject to corrosion. Apathy to its control can be laid to managers who are slow to see the direct losses from corrosion, and to connect the indirect losses with their cause. But the fault is not all theirs. Some of their engineers and operators have failed to sell them on the value of control measures. These, of course, cost money that requires budget approval. Thus education of management in the economic value of corrosion control is prerequisite to the great conservation it can achieve. This includes explaining the cooperation needed to avoid cathodic interaction.

Encourage Corrosion-Preventive Practices. Operators, too, can conserve metal by avoiding corrosion. For example, during construction as well as operation, needless underground corrosion can be prevented by avoiding the disposal of waste matter or effluent where it may pollute the soil in or near the plant. Effective surface drainage will minimize this likelihood.

Encourage Joint Ventures. Most exceptional opportunities, requiring management support as well as engineering know-how, are the joint ventures becoming common in the oil business. We see the pooling of interests in foreign development. But at home, too, are fine examples of joint action to build refineries and pipe lines, and to unitize field development and field plant operation. Building a single large facility instead of several small ones permits a minimum use of new equipment, supplies, and services per unit of capacity. Here is conservation to really brag about.

Consider Oil-Field Unitization. A further boon attends unitization of producing properties. This permits efficient reservoir control, affording maximum ultimate recovery of the oil and gas. Thus we conserve natural resources as well as

the manpower and materials required for their development. Oklahoma has taken the lead in legislation to override short-sighted minor obstruction of oil- and gas-field unitization.

WHAT ENGINEERS CAN DO

Opportunities for engineers to conserve general manpower and materials are endless. I can best present a few by example.

Standardize Recurring Layouts. Consider routine field and plant development. Drilling and production equipment installed recurrently lends itself to standardized layouts. So does field equipment in the pipe line. For example, well-engineered standard layouts for setting and connecting gathering pumps as well as lease tanks will save pipe, fittings, and many hours of crew fumbling. Standard setting of field engines will enable a spare to be installed quickly so the regular unit can be repaired properly in clean and well-equipped shops.

Apply Laborsaving Equipment. Laborsaving equipment and automatic devices were mentioned before. The manager's part is to approve their use and purchase. But usually the engineer must analyze and prescribe such equipment, and must find application for the devices. This requires keeping abreast of their development and being alert as to their need. The engineer also can assist in development, but he will do well first to make the best use of equipment available.

Technically Guide Operations. Engineers can aid conservation in routine operations. For example, my pipe-line company spends nearly three million dollars yearly on public-service electric power for electric motors to drive centrifugal pumps. Here minimum use of such power is important. Our engineers help in at least three ways. They decide full-load pressures for the several pumps in a station so, for different throughputs, the pumps can be put in different series combinations for optimum full-load efficiency. They prescribe the trimming of pump impellers to attain this efficiency, and they aid the dispatchers in scheduling movements so as to improve load factor.

Design Against Corrosion. Prime opportunities occur in design. Consider corrosion control. This properly starts with the design of structures and equipment so as to minimize corrosion possibilities. Such includes the selection and placement of materials resistant to corrosion—and avoiding the contact of certain dissimilar metals. Underground corrosion can be minimized further by insulating structures from soil and water, and by locating them so as to minimize their susceptiveness to railway and cathodic stray-current damage.

Design Against Wear. Equally important is the use of materials resistant to wear. Most of the seven million barrels of oil we produce, transport, and refine day after day are caused to flow and flow and flow by the propulsion of moving mechanical parts. Thus the development and use of wear-retardant valves, cylinders and pistons, cases and impellers, and the like, offer a most fertile field for conservation.

Contract Wisely. Engineers can save, too, by careful attention to contract award and performance. For example, the plans and specifications should clearly permit effective competitive bidding. Some contractors may be allowed to bid only to keep them happy. In any event, all bids should be analyzed with the ability of the bidder to perform in mind. If incompetent low bidders are allowed to try, and must later be run off the job, great wastes of time and future plant service may follow. Job inspection should be competent and sympathetic, working with and not against the contractor to save delays and the redoing of poor work.

CONSERVING "ENGINEER POWER"

Many other ideas—some better than those just given—can be suggested for use by engineers to save men, equipment, and materials. Thus we need not dwell further on this phase. But while we are conservation-minded, we perhaps should consider certain personal work habits to the end that our industry may better conserve engineer-power! A foible is a "weak point" or "whimsy." I propose to discuss some engineers' foibles that retard conservation.

Improve Contacts for Planning. Reference has been made to the energy lost in duplication of planning between head office and the divisions. This is a common cause of engineer waste. Insufficient or poorly organized contact usually is the cause. A more serious effect is that planning may be delayed because each office expects the other to do the job.

Look for Basic Factors. Some engineers seem unable to find the basic factors in their problem and its solution. They "miss the forest for the trees." A simple example was the development 23 years ago by your speaker of the "ton-mile" formula still used daily in most drilling rigs to measure wire-rope service. Dozens of things can effect the spoilage of drilling cables, and it seemed that all of these should be considered. But when the idea was suddenly grasped that a rope does work in the true physical sense, and that work is merely the product of force (or weight) and distance, a long confusion was cleared and the key formula was found in a few hours.

Avoid Preconceived Ideas. Other engineers approach their problems too rigidly. They start with hunches that blind them to the facts. Another simple personal example—and you will pardon my pride in telling it because it altered my own career—was development 34 years ago of the formula still used daily at all military and civilian weather stations to determine the ascensional rates of hydrogen-filled meteorological balloons. How to predict this rate was the problem. For years the hunch players had tried to equate the first power of the lift and the square of the diameter without avail. Five days of the simplest open-minded experimentation in a closed building proved they should use the $^{5}/_{8}$ power of the lift and the 1.25 power of the diameter. Not a major discovery, but it enabled 600 meteorologists of the Army Signal Corps overnight to double their service to the artillery and planes in France, and the flying fields at home.

Compromise With Perfection. In design work, engineers often refuse to compromise with perfection. For example, they design a plant needing a heat exchanger. Many types and sizes of exchangers are commercially available. Yet the perfectionist must take an expert's time to specially design one, and cause the added delay of having it hand-built in the shop. A very few such actions can cause more service loss through delayed plant completion than can be made up in many years by the marginal 0.00X per cent increase in efficiency to be gained.

Make Use of What's at Hand. With present shortages, all engineers perhaps must adapt themselves more and more to the use of what's at hand—at hand perhaps in the scrap—or bone yard, let alone in the catalog! Our field welders and shopmen, who seem able to make almost anything out of leftovers, can give our designers a few lessons if need be. The expedient use of available components is a "must" for conservation during our emergency.

Use the Sales Engineers. From their ivory towers, certain operators' engineers look upon sales engineers as glad-handing nuisances. And sometimes they are right. In my youth a sage remarked: "Two hybrids have no place in the oil business—the salesman who poses as an engineer, and the engineer who poses as a salesman!" But the modern sales engineer is schooled to give the consumer real technical help in the application of his specialty. Also he can give information on what others are thinking and doing. Most of us rely heavily upon him. Others who habitually view him askance are wasting

(*Continued on page 404*)

BRIEFING THE RECORD

Abstracts and Comments Based on Current Periodicals and Events

J. J. JAKLITSCH, JR., *Technical Editor*

MATERIAL for these pages is assembled from numerous sources and aims to cover a broad range of subject matter. While few quotation marks are used, passages that are directly quoted are obvious from the context, and credit to original sources is given.

Industrial Sight Conservation

A WORKING program for the elimination of industrial eye injuries, emphasizing the need of greater attention to all aspects of the problem by industrial management and the engineer, was described by Robert S. Krueger, director of industrial service, National Society for the Prevention of Blindness, New York, N. Y., at a joint session of the Safety and Management Divisions during the 1951 ASME Annual Meeting in Atlantic City, N. J.

As an element of industrial safety, said Mr. Krueger, sight conservation and utilization involves the following two types of activity:

1 Controlling of visual efficiency factors, including those relating to the improvement of vision and the visibility of the task, and to better application of the employee's visual skills in view of the job's visual requirements.

2 Guarding against direct injury to the eye from flying particles, radiant energy, and injurious materials in the form of dust, vapors, fumes, liquids, and molten substances.

The incidence of complete loss of sight can be appreciated when it is realized that the estimated blind population is 260,000 in the United States today. Authorities declare that more than half of such blindness could have been prevented through application of the information already known to medical science. The cost of maintaining the blind is over $125 million annually in tax funds and through other expense, in addition to the untold human suffering. There are 22,000 newly blinded individuals in the United States each year, or an average of 420 each week. It is estimated that 17 per cent of all blindness cases reported are due to injuries, most of them occupational. Their cost in compensation, lost production, medical, and various indirect expenses exceeds $250 million per year. In compensation alone the average cost of a disabling eye injury is approximately $350, which is more than double the average cost of all other types of occupational injuries. Better than 98 per cent of all industrial eye injuries can be prevented through acceptable standard safety practices.

OCCUPATIONAL VISION PROGRAM

According to Mr. Krueger, the sight-conservation program can be summarized in the following standard and universal six-point outline, as advocated by the National Society for the Prevention of Blindness: (1) Testing for the five basic visual skills, (2) analysis of jobs for visual factors, (3) eye-safety equipment with correction for the job, (4) emergency eye care, (5) proper use of illumination and color, (6) group and individual education in eye health and safety.

1 *Vision Testing.* As a general practice in the past, vision has been tested as part of a routine physical examination usually, and only at the time of employment. Tests involved measurement of acuity alone, by reading of a wall chart at 20 ft. Sometimes a near-point reading test was made, using a hand-held card.

More recently, and particularly since the last war, with the availability of modern battery-type testing equipment, it is now generally agreed that a more satisfactory visual check will include findings on the following skills: (*a*) Central visual acuity at near, far, and work distance, (*b*) field of vision, (*c*) muscle balance, both vertical and horizontal, (*d*) depth perception, (*e*) color discrimination.

For example, in selecting workers for inspection of finished metal parts about 6 × 8 in. in size, good acuity would be necessary at usual near-point viewing distances, or about 18 to 20 in. Where work is done on a moving unit, or if rapid sampling and gaging is part of the inspection, good eye-muscle balance is also essential. Most machine-tool jobs, looping and seaming in the hosiery industry, machining in the watchmaking or jewelry trades, assembly of small electronic tubes, and others, are occupations in which very short viewing distances of under 8 in. are required and in which the operator must have exceptional near-point vision.

2 *Analysis of Jobs for Visual Factors.* The visual task must be evaluated to know how much and what degree of vision is needed to perform the operation efficiently and safely. Knowing the job's visual demands makes it possible to place an employee or adjust him to work where he will be best adapted.

3 *Eye Safety Equipment With Correction for the Job.* This is a two-step problem. First, processes and equipment can often

How to Obtain Further Information on "Briefing the Record" Items

MATERIAL for this section is abstracted from: (1) technical magazines; (2) news stories and releases of manufacturers, Government agencies, and other institutions; and (3) ASME technical papers not preprinted for meetings. Abstracts of ASME preprints will be found in the "ASME Technical Digest" section.

For the texts from which the abstracts of the "Briefing the Record" section are prepared, the reader is referred to the original sources: i.e. (1) The technical magazine mentioned in the abstract, which is on file in the Engineering Societies Library, 29 West 39th St., New York 18, N. Y., and other libraries. (2) The manufacturer, Government agency, or other institution referred to in the abstract. (3) The Engineering Societies Library for ASME papers not preprinted for meetings. Only the original manuscripts of these papers are available. Photostat copies may be purchased from the Library at usual rates, 40 cents per page.

be properly safeguarded to eliminate or control to a minimum the source of eye hazard. Second, practical types of eye protective equipment, properly designed to guard against the specific type of hazard on each job, must be available.

4 *Emergency Eye Care.* Adequate professional medical services for prompt treatment of eye injuries must be provided.

5 *Proper Use of Illumination.* Sufficient illumination should be provided to allow for proper foot-candle levels without glare, generally diffused, and free of shadow. All general plant areas and work locations should be checked against the American Standards Association's recommendations for industrial interiors and improvements made accordingly.

6 *Group and Individual Education in Eye Health and Safety.* As with all other phases of a good safety program, the usual media are generally used in promoting control with eye problems. Posters, films, special campaigns, and incentive programs such as the Wise Owl Club of America are recommended.

VISION PROBLEMS AND THE ENGINEER

Engineering techniques, Mr. Krueger emphasized, are essential in the very first step in eliminating eye injuries—that of controlling the hazards at the source. Here the design engineer must devise guarding equipment to eliminate or minimize exposure to eye injury. His solution may be suitable hoods or enclosures on a hazardous operation, providing guards or exhaust systems in mechanical handling of dangerous materials, rearranging of the operation sequence to eliminate or control a hazardous condition, or with any one of innumerable similar methods. He provides engineering service as a vital feature in adequate control. Similarly, the illuminating engineer has an evident interest in the design problem as it is found in the job visual environment throughout the entire production schedule. Job analyses made to determine visual demands require the services of many engineering specialists, particularly industrial engineers qualified with experience in work simplification, time and motion study, and job evaluation.

New Thermodynamics Concept

A NEW concept in thermodynamics, that presents a new flow equation to bring theory into line with experience, has been advanced by Prof. Neil P. Bailey, Fellow ASME, Russell Sage professor of mechanical engineering at Rensselaer Polytechnic Institute, Troy, N. Y., in an article appearing in *Power* for March, 1952.

According to a *Power* summary of Professor Bailey's theory, it is pointed out that for many years standard thermo books have presented a certain "general energy equation" as a foundation for the solution of problems of steady fluid flow. Up to now, deviations of experimental results from theoretical predictions were blamed on experimental and instrumental errors. In recent years, however, these discrepancies have become too great to be explained away.

Refusing to accept this unsatisfactory situation, Professor Bailey questioned the accepted concepts of thermodynamics. The result is a logical revelation of hidden fallacies and a new different flow equation, which checks closely with experiments on air and water.

Complete understanding of these new ideas demands the ability to follow the pattern of Professor Bailey's mathematical logic, but the following comments give the drift of this important revision in the basic sciences:

The standard steady-flow equation for water, steam, or gas kept its eye on one pound of substance as it flowed through the process. According to this long-established theory, the total energy of the pound remains constant in steady flow. This constant total was assumed to be composed of four parts: (1) potential energy, (2) kinetic energy of the moving mass, (3) internal energy of the dancing molecules, (4) pressure times specific volume. This last was supposed to be a measure of the energy "stored" in the fluid because it is under pressure.

Professor Bailey concludes that item (1) is an illusion because the fluid neither knows nor cares how far it is elevated above some arbitrary datum line of altitude. Then he wipes out (4) as a mere "counting your chickens twice," since the internal energy, item (3), is the total energy "in" the substance.

Finally, Professor Bailey finds it unprofitable to pursue one pound of substance through the equipment like a policeman chasing a suspected car. Instead, he seats himself at a "toll gate" and watches energy roll by. His new equation states that energy flow past one gate is the same as that past any other, if no energy is added or removed.

This total has three parts: (1) The internal energy in the pounds that pass the given point in one second, (2) the kinetic energy in the pounds that pass in one second, and (3) what Professor Bailey calls the "transmitted energy" per second. To get this last he multiplies pressure by duct-section area to find the push on an imaginary moving piston. This push, times the velocity, measures the transmitted energy per second.

An RPI News Bureau release points out that if Professor Bailey is right, the disastrous stalling of fast aircraft, the high-speed failure and inefficiency of many heat-power machines such as steam and gas turbines, jet engines, compressors, and guided missiles may be avoided in future designs.

The new method permits the designer more accurately to predict what will happen within a speeding machine. It will also affect the design of such machines as pumps and marine torpedoes where speeds are cut by vacuums forming behind the driving blades.

The real importance of the discovery, according to RPI, lies in giving the designer a better understanding of the processes he is trying to control. For new machines and for improvements of old machines, this should help to reduce expensive cut-and-try development and ultimately pay off in lower first costs, lower operating costs, and safer equipment.

Scientific Research

MAJOR support by the United States Air Force of post-graduate education in American universities is implied in the establishment of the Office of Scientific Research, announced by the Air Research and Development Command, according to the CADO *Technical Data Digest*, March, 1952. This step marks an increased emphasis in basic research performed in the nation as well as within the Air Force, and in furthering understanding of the value of basic research to the Air Force Mission.

Basic research is distinguished from applied research and development in that it is the study of scientific phenomena to produce understanding. Applied research and development is more closely allied to immediate results of benefit to weapons, systems, machines, devices, or techniques. Air Force basic research, however, makes available the fundamental knowledge required as a starting point for applied research, and for development to produce the necessary air weapons which maintain this nation's security.

One way this basic research objective will be accomplished by the Office of Scientific Research is through sponsoring of graduate scientific study and research, particularly in fluid mechanics, physics, chemistry, and mathematics. The OSR will work with educational and industrial organizations, initiating and administering a program of research through contracts, es-

pecially in broad fields of interest to the Air Force. The use of graduate skills in carrying out these contracts will be encouraged.

University and research organizations interested in co-operating with the Air Force in this program should communicate with the Office of Scientific Research, Air Research and Development Command, P.O. Box 1395, Baltimore 3, Md.

Trepanning

IT is only in recent years that the principle of trepanning (producing reasonably large holes by cutting a cylindrical groove and removing the center in a solid core) has been applied to the machining of accurate bores in metals, according to an article by Fred W. Lucht, Mem. ASME, development engineer, Carboloy Department of General Electric Company, Detroit, Mich. Of particular interest at present is the application of the process to the drilling of gun barrels at a rate impossible with boring tools or conventional spade drills. Fig. 1 shows a trepanning head used for this operation.

Holes up to 30 or 40 ft or more in length, and up to $4^1/_2$ in. in diam have been produced in steel forgings in this manner and to tolerances of only a few thousandths of an inch as to concentricity and diameter.

The advantages of the process, however, are not confined to deep holes, states Mr. Lucht. The process may be applied equally well in producing through holes in such parts as gear forgings, etc., thereby greatly reducing machining time. Accuracies, in general, will be better than when drilling, provided the equipment used is satisfactory.

In general, timesavings obtainable by deep-hole trepanning with carbides as compared with producing the same hole with high-speed drills may run as high as 95 per cent. Part of this saving is due to the higher cutting speeds and feed rates made possible by the carbide tip used on trepanning tools. However, the major part of the saving is still due to the simple fact that far less metal has to be removed in the form of chips.

FIG. 1 TYPICAL TREPANNING HEAD USED FOR THE DRILLING OF GUN BARRELS

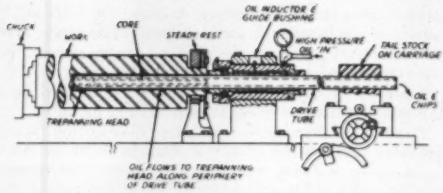

FIG. 2 DIAGRAMMATIC OUTLINE OF A DEEP-HOLE BORING MACHINE CONVERTED FOR TREPANNING WORK

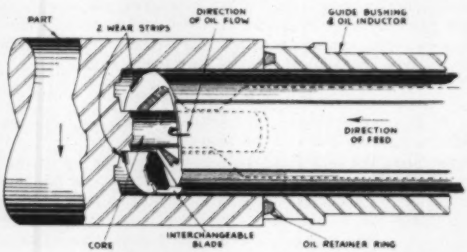

FIG. 3 CUTAWAY DIAGRAMMATIC SKETCH SHOWING TREPANNING HEAD SLIGHTLY RETRACTED AFTER STARTING A CUT

According to Mr. Lucht, trepanning is a "natural" for carbides for the following reasons:

1 The long life of the carbide insures continuity of cutting, as well as maintenance of closer tolerances as to diameter at the end of the bore as compared with the diameter at the beginning.

2 Higher cutting speeds and feed rates are possible with carbides.

3 The trepanning cutter body carrying the trepanning cutter blade must be protected against wear as it bears against the ID of the hole. Here again, carbide wear strips provide an excellent answer.

4 Proper carbide speeds can be obtained over entire cutting edge of a trepanning tool. (The dead center on a spade-type drill makes it unsuitable for carbides.)

To give an idea of the savings possible by trepanning instead of drilling, the following example may be of interest: Work, 18-ft long, rough-turned steel forging; hole, $2^{13}/_{16}$ in. to be produced entire length; feed, 0.008 in. per revolution; speed, 550 sfpm (747 rpm) at outer edge of tool; accuracy, hole held within 0.003 in. for size, and within 0.012 in. for alignment.

At the speed and feed used, total feed was 6 in. per min, giving a total cutting time of only 36 min. This compared with an established drilling time of 15 hours when using high-speed-steel spade drills including time required for three drill changes.

At the present time there are few machines built in this country which were designed specifically for trepanning work. However, it is entirely feasible to convert existing deep-hole-boring machines or lathes to such work, Fig. 2.

Chief requirements for a trepanning-machine conversion are as follows:

1 Adequate motor horsepower. In the foregoing example,

46 hp was required. Usually 60 hp or more is desirable for good performance, depending on hole size and material.

2 An oil pump capable of delivering 25 gpm or more, at a pressure of at least 175 psi, was required for the afore-mentioned job. The volume of oil required will vary with the hole size.

3 A carriage fixture to support and permit accurate feed of the tube on which the trepanning tool is mounted.

4 An oil inductor bushing and support which also provides an oil seal at the entrance end of the bore.

5 Steady rests to support the work.

6 Centralization of all electrical controls and indicators at or near point of chip outlet.

7 Variable-speed control for the motor.

8 Gearless headstock.

9 Cutting-fluid temperature and oil pressure gages.

The trepanning cutter head, Fig. 3, is attached to the non-revolving drive tube. Two types of cutter blades are currently used: a $^3/_8$-in-wide cutter blade for holes $1^3/_4$ in. up to as large as 8 in.; cutter blades $1^1/_4$ in. wide have been applied successfully to trepanning of large-sized bores. Selection of cutter-blade size depends considerably on operating conditions and horsepower available. With the $^3/_8$-in. cutter blade, oil is fed under pressure to the cutter head through the space between the drive tube and the ID of the hole and is discharged along with the chips through the space between the ID of the tube and the core. With the larger cutter blade, the flow is reversed, since it has been found that discharge of the cutting fluid and chips around the periphery of the drive tube is advisable when trepanning larger holes.

A typical cutter head used for holes 8 in. or less in diam and employing a $^3/_8$-in-blade is shown in Fig. 3. Note that the carbide cutter blade and the carbide wear strips project slightly beyond the OD of the head providing a passage for the coolant to the cutting area.

Fig. 4 shows the detail design found to be most satisfactory thus far for $^3/_8$-in-wide cutter blades. Since chips must be broken up as small as possible for ready washing out by the cutting fluid, the cutter blade has three distinct cutting edges so that three separate chips are produced. The center portion of the cutting edge "leads" and the two sides follow. Each cutting-edge portion has its own step-type chip breaker to break up the chips formed by that portion. Grade 78 has been found satisfactory for the tip for trepanning any steel within a 200–400 Brinell-hardness range.

Best material for the wear strips appears to be grade 78. Best cutting speeds range from about 600 sfpm for steels in the 200–250 Brinell range to approximately 400 sfpm for those up to 400 Brinell. These speeds are for the outside edge of the blade.

Feeds of 0.006 to 0.010 in. per revolution have been found to work very well but best feeds for each type of job may require some modification. The important thing is to produce a fairly heavy chip. This reduces cutter-blade wear. The chips, however, should be broken up until they are small enough to pass freely through the discharge space. Feed should not be reduced if speed is increased or vice versa. In some instances, although the chips theoretically may be small enough for easy passage, the coolant pressure must be increased to flush them out properly. This is especially true when nearing the end of extremely deep holes.

It is important that the correct cutter-blade grind be secured right at the start. Wear strips are cylindrically ground in position before inserting the blade. The cutter blade is also cylindrically ground (to a slightly larger diameter as shown after assembly in place).

Chip-breaker size should not be changed when speed is changed. The size shown in Fig. 4 has been found to be satisfactory in most applications.

Trepanning speed depends on material being machined. With materials of 275 or 375 Brinell, cutting speeds of 500 to 600 sfpm (at bore diameter) have been found to work well. Somewhat higher speeds may be used for materials of lower hardness.

In some cases trouble has been experienced from extremely fine particles carrying through the conventional filter. Use of a special filter employing Carboloy permanent magnets has been found helpful in such cases by keeping these chips from getting into the pump where they can cause fairly rapid wear.

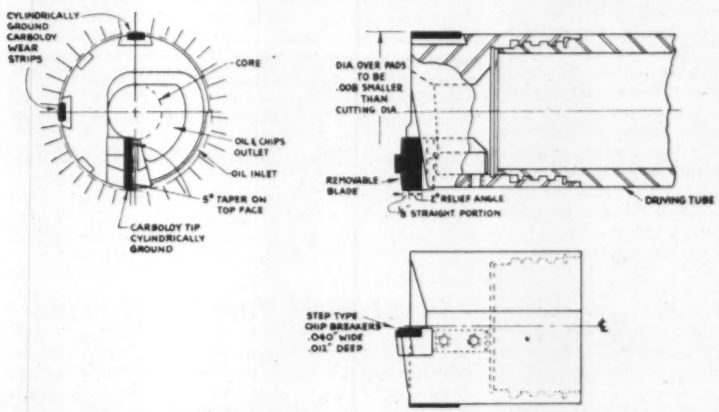
CYLINDRICALLY GROUND CARBOLOY WEAR STRIPS
CORE
OIL & CHIPS OUTLET
OIL INLET
5° TAPER ON TOP FACE
CARBOLOY TIP CYLINDRICALLY GROUND
DIA OVER PADS TO BE .008 SMALLER THAN CUTTING DIA
REMOVABLE BLADE
5° RELIEF ANGLE
STRAIGHT PORTION
DRIVING TUBE
STEP TYPE CHIP BREAKERS .040" WIDE .012" DEEP

FIG. 4 DIMENSIONAL SKETCH SHOWING SPECIFICATIONS FOUND IMPORTANT TO DATE IN SUCCESSFUL TREPANNING OPERATIONS

Radio-Controlled Lifeboat

A RADIO control for an air-borne lifeboat that can be dropped by parachute from an airplane and unerringly guided to survivors in the water has been announced by Westinghouse Electric Corporation, Pittsburgh, Pa.

The electrical control system that uses a radio signal from the air to control the engine and equipment for driving and steering the boat has successfully passed trial runs at Lake Pymatuning, 25 miles north of the company's Transformer Division at Sharon, Pa., as well as final tests conducted by the U. S. Air Force at Mobile, Ala.

The control system for the lifeboat was designed around a radio transmitter-receiver set developed by the Wright Air Development Center, Wright-Patterson Air Force Base, Dayton, Ohio.

After the 30-ft-long craft is dropped by parachute into the sea from the rescue airplane, radio signals at five different

frequencies take over complete control in individual stages. The stabilizing fins that hold the boat steady as it leaves the plane are jettisoned. A guard protecting the propeller and rudder is freed. The engine air vents are opened. The motor is cranked up and automatically choked. Following this, the clutch is engaged and the throttle advanced to send the craft forward under the guidance of the radio controller.

When the lifeboat reaches the survivors, the air-borne operator can bring it to a halt until the survivors board and then set the boat on its course again. If the physical condition of the rescued men is good, they can take over control of the boat themselves. If they are too weak for this activity, the air-borne operator can guide them to shore or a rescue surface ship. The boat is equipped with triple controls, permitting passengers to break off radio control at any time and operate it electrically or manually.

The first set of operations after the boat strikes the water consists of the foregoing five separate stages. The radio signal controlling these functions is transmitted to the boat at a frequency of 955 cps. Another radio signal—this one at 3000 cps—now goes into action. The gear shift is advanced from neutral to forward and at the same time the throttle is advanced to half speed. To turn the boat left, a radio signal of 650 cycles acts on the magnetic-compass steering mechanism. For a right turn a signal of 300 cycles is used.

For emergencies, the air-borne operator can use a fifth frequency of 1390 cycles. In the event that the magnetic-compass steering system should not work, this signal by-passes it and works directly on the steering apparatus itself.

If the survivors are too weak to handle the boat manually—and if contact with the rescue plane is lost—a push-button control system is available.

The 3500-lb craft can hold 15 men, with provisions for 10 days and fuel for an 800-mile cruise. It is also equipped with "walkie-talkie" radio sets for boat-plane communications, a machine for distilling fresh drinking water from sea water, and a zipper canopy to protect survivors against the broiling sun.

Coal-Barge Unloader

A NEW coal-barge unloader, said to be the world's fastest, recently began operations at the Coke Plant of Jones & Laughlin's Aliquippa Works. This giant machine is part of the new coal-handling facilities designed, fabricated, and erected for J & L by Heyl & Patterson, Inc., of Pittsburgh, Pa.

Designed specifically for this operation, this modern barge unloader, with an average unloading capacity of 1350 tons of coal per hour, contains several unique features besides its unloading speed.

Coal is unloaded from the barge by means of a coal hoist consisting of an 83-ft-long bucket-type elevator. As the loaded barge is moved slowly past the coal hoist, each of the continually moving elevator buckets takes a $^1/_7$-ton bite from the coal pile and carries it to the top of the unloader where it is dropped through a coal crusher and on to a conveyer.

Only three passes of the barge are necessary for complete unloading.

A special feature of the coal hoist is that it can be raised or lowered 38 ft to allow a barge to pass underneath or to compensate for the height of the river and the height of the barge when unloading. The coal hoist can operate equally well from any height.

The barge is kept in the unloading position by snubbing lines to prevent drifting away from the dock and by three barge positioners which keep the barge from drifting into the dock. These barge positioners fit into the face of the dock and operate like huge doors, pivoting out from the dock as much as five feet to contact the barge. Each of the three positioners is capable of independent movement which enables the operator to keep the barge in exactly the right position at all times. This results in such complete unloading that no clean-up men are needed in the barge at any time.

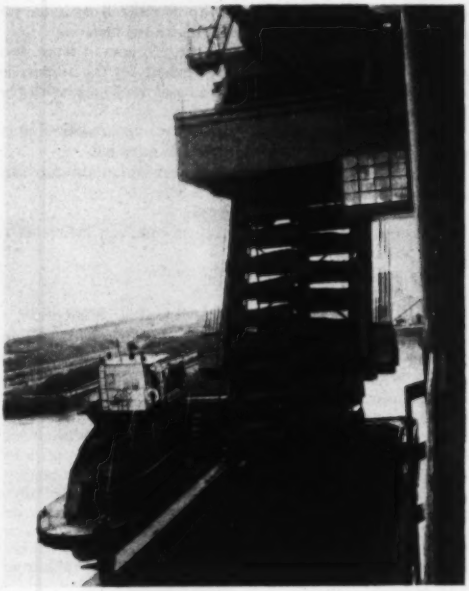

FIG. 5 WORLD'S FASTEST COAL-BARGE UNLOADER IS SHOWN UNLOADING COAL

(The operator's cab can be seen to the right of the coal hoist. One of the three special barge positioners can be seen in the lower right keeping the barge in place.)

The barge positioners are also used to push the barge away from the dock after unloading with no help from a tugboat.

The movement of the barge while being unloaded is controlled by two barge-haul engines, one for forward movement and one for backward movement. This enables the operator to move the barge speedily and to keep it perfectly aligned.

The movements of the barge itself, the coal hoist, the elevator, and the barge positioners are all controlled from the operator's cab.

At the top of the hoist the coal passes through a coal crusher and is transferred to a conveyer. A reversible belt shuttle conveyer then receives the coal and deflects it into one of four 500-ton surge bins where the coal can be stored until needed. From the surge bins the coal is delivered, by another conveyer system, for further processing and then to the coke ovens.

Centrifugal-Pump Test Stand

A SERIES of newly designed centrifugal-pump testing stations which have reduced over-all test costs 75 per cent during a 12-month trial period, have been completed recently by De Laval Steam Turbine Company, Trenton, N. J., according to Paul Nurko, Jun. ASME, test superintendent of the company.

The stations are engineered to give a complete reproduction of performance for pumps of all sizes and ratings. They have also proved valuable in research and development processes for new designs.

These test stands are permanent installations consisting of a double-ended, electric dynamometer mounted on an automatic lift located between two prealigned pump bedplates. The lift is powered by an electric motor operating through a self-locking gear train and is controlled by push buttons so placed that the test erector can readily secure proper height alignment within 0.022 in. One of the stations is capable of testing pumps up to a 6-in-diam discharge and requires the dynamometer to be set at various heights for the various-size units. Signal lights and safety controls are built in for the dynamometer lift.

The test erector has no need for a variety of tools on this test stand. Pumps of one rotation are coupled to one end of the dynamometer shaft, while pumps of the opposite rotation are coupled to the opposite end. The dynamometer is equipped with specially constructed sliding-type couplings on which coupling bolts are permanently mounted. The accuracy with which the pump supports are machined and drilled makes it possible to use special doweled pads. The pumps are automatically aligned laterally when set on the pads. Equipped with special clamping and alignment fixtures, the pads reduce aligning time to a matter of minutes. An electrically operated one-ton crane simplifies pump handling.

The test station features a system of piping which simulates actual field installation. Pump suction piping includes a movable manifold deeply submerged in a swirl or vortex-free pool of water. The interconnected reservoirs of water have a total capacity of 400,000 gal. Special eccentric pipe reducers provide means of piping pump suction to the manifold and quick connecting adapters are used for pipe connections. The water is discharged through a specially constructed flexible hose that carries the liquid into a pipe system below the operating level.

Water is then metered through a bank of calibrated Venturis that can be operated singly or in parallel. The system head is low and by the use of a motor-operated valve, additional friction is created so that pumps are tested over a wide range of heads. The pipe system requires no priming and is free of air locks. Suction lifts are applied to the pump from the control desk.

The test engineer operates the unit and conducts tests from a control desk and control panel which contains highly sensitive and accurate test instruments. The Venturi manometers are calibrated to read directly in gal per min with the graduations so arranged that capacities may be read closer than possible with a rule. Given flows are then set by the operator with a button-controlled valve. Sensitive and accurate gages are used to measure discharge pressures. These gages could not be ordinarily used in a nonpermanent installation because of the ever-present threat of handling damage. Calibrations are made of all instruments in their relative positions and no handling is required. A gage tester is mounted in the control cabinet so that calibrations can be obtained in a matter of seconds. Three laboratory-type gages for measuring pressure have full scale readings of 75, 150, and 350 ft, respectively. To supplement the pressure gages, the manometer panel has two manometers reading directly in feet of water, and an additional manometer to measure the lift applied to the pump. Using a special vertical trap, the suction lift is referred to a constant water level.

A standard springless scale is used on a fixed motor arm to indicate the motor torque. This method has proved to be most reliable and trouble-free for indicating the absolute value of the torque. By the use of selsyns, the torque may be read to the tenth of a pound on one of the control-panel dials. For the test engineer's use, a field and armature ammeter and a voltmeter are included.

The dynamometer speed is controlled from the desk by use of two field rheostats. With the vernier rheostat, the speed may be adjusted to the exact value for which the pump is designed to operate. Voltage fluctuations are practically negligible with the use of a voltage regulator.

The speeds are set approximately with a synchronous electric tachometer, and held accurately by means of a stroboscopic light. Through a specially colored, marked, transparent disk revolving in synchronism with the pump shaft the speed is held constant. For calibration of the electric tachometer, the average speed may be measured within one revolution per minute by using an automatic synchronous counter. All speed instruments are mounted in the control panel beneath the pressure gages. Arrangement of instruments in the control panel pro-

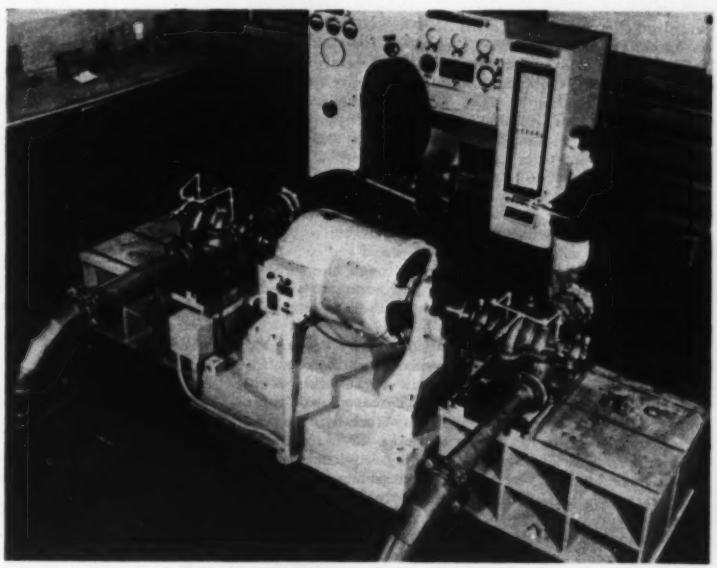

FIG. 6 CENTRIFUGAL-PUMP TEST STAND

(Test stand consists of double-ended electric dynamometer mounted on an automatic lift located between two prealigned pump bedplates. In rear center is control desk and manometer panel.)

vides the engineer with clear vision in the observation and recording of test data.

Before the start of a pump test, the test engineer carefully reads an engineering order card that states the complete hydraulic data: discharge pressure, suction head, rate of flow, specific gravity N.P.S.H., submergence, and horsepower required. The data pertaining to the motor are also given: full-load speed, voltage, and horsepower. The customers' operating conditions are then simulated at the control desk and the test engineer operates the pump at the rated speed of the customers' motor and records data for a minimum of six test points. Readings of pressure, flow, and power input are taken only after conditions are stable. The standard test follows all procedures of the latest hydraulic codes.

By conducting tests in this manner, with laboratory instruments, the calculation of test results can be made without the need of theoretical corrections. This is assurance that the pump has satisfactorily met the specified conditions. To complete the test program, a mechanical check-off list is prepared which contains such vital records of operation as vibration, temperature, and noise.

The existence of a sound and complete test policy as a major part of quality control is substantial reason to believe that a trouble-free pump is reaching the customer. Shop test installations like this, which simulate actual industrial service, is another step in high-quality manufacturing methods that insures quality and performance regardless of the rating of the pump.

Aeronautical Research

DURING 1951 there has been an increase in research directed specifically at the problems of high-speed airplanes and guided missiles, according to the 37th Annual Report of the National Advisory Committee for Aeronautics.

Aerodynamic research to permit efficient operation of airplanes at transonic speeds has continued to receive special emphasis, and information has been obtained in this speed range from flights of special research airplanes, rocket-powered free-flight models, freely falling bodies, and from very small models on wind-tunnel bumps or by the wing-flow method in flight. There has, however, been a serious need for techniques to permit detailed systematic large-scale experiments to be made in wind tunnels through the speed of sound. As a result of extensive research on wind-tunnel design, suitable techniques have been developed, and the Langley 8-ft and 16-ft wind tunnels were modified to permit testing through the speed of sound. These modified tunnels are contributing to a better understanding of aerodynamic problems in the transonic speed range.

Theoretical and experimental research on high-speed airplane design problems has been directed generally at the establishment of technical information to permit the selection of the most efficient configurations for flights at transonic and supersonic speeds which will also have satisfactory flying characteristics at low speeds for landing and take-off. As the high-speed requirements increased, the landing requirements have become more difficult to meet and it has been necessary to continue research at low speeds on these problems, the report states.

In addition to studies of performance problems of guided missiles, considerable attention has been directed during the past year to the problems of stability and control. In this field particular emphasis has been placed on the cross-coupling effects experienced by various missile configurations and on automatic-control problems.

AIRCRAFT POWER PLANTS

With the ever-increasing trend for aircraft operation at higher altitudes and higher Mach numbers there has arisen a multitude of complex power-plant problems. Efficient diffusers at high Mach number, greater air-flow handling ability of compressors, increased combustion efficiencies at high altitudes without blowout or instability, increased turbine-inlet gas temperatures, reduction of strategic material content, increased thrust augmentation with afterburners, and the over-all engine control and component matching require extensive power-plant research. For the purpose of obtaining the most efficient operation of each part of the power plant, these problems have been approached through theoretical and experimental investigations. Power plants, such as the turbojet, the turbopropeller, the ramjet, the rocket, and combinations of these engines utilizing chemical and nuclear fuels are currently under investigation. As a result of this research, improved subsonic and supersonic operation of the interceptor, the long-range bomber, and the guided missile can be expected.

AIRCRAFT CONSTRUCTION

According to the report, the NACA is continuing its efforts to enlarge the scope and the amount of its research on airframe-construction problems.

Programs during the past year have included extensive laboratory and flight research and the continued collection of statistical data on gust loads encountered in regular airline operation. All airframe-construction problems have been complicated by the increasing altitude and speeds of flight and these two factors can be found at the root of most new structural-design problems.

As in the past, a considerable amount of the NACA research on structural materials and structures was performed under contract at universities and other nonprofit scientific organizations.

OPERATING PROBLEMS

Investigations have been continued of the meteorological conditions adverse to the performance and safety of flight, means of accurately measuring air speed and static pressure at transonic and supersonic speeds, principles of design of aircraft systems for coping with natural icing conditions, and methods of improving aircraft safety. Research on atmospheric turbulence, aircraft ditching, and air-speed measurement have been conducted by the Langley Aeronautical Laboratory, while studies of natural icing conditions, aircraft ice-protection systems, and aircraft-crash fires have been conducted by the Lewis Flight Propulsion Laboratory. The Ames Aeronautical Laboratory has also done limited work in the field of aircraft icing. The work of the NACA laboratories has been supplemented by research conducted by several universities under contract to the NACA.

Russia's Jet Progress

RUSSIA'S jet history, writes Jan C. Morton in a recent issue of the *AVRO Canada News*, started in the spring of 1945, when an aircraft known as the MiG-7 flew for the first time. This machine consisted simply of a standard piston-engined MiG-3 airframe containing a modified German Jumo 004 turbojet. Data obtained from this experiment enabled Soviet technicians to make a speedy start on the design of the MiG-9, a twin-engined jet fighter of similar aerodynamic form, which entered service later in 1945.

It was about this time that Russia received from Great Britain a consignment of 55 jet motors and spares. During 1947 and

early 1948, 30 Rolls-Royce Derwent 5's and 25 Nene 1's were delivered into eager Soviet hands.

From then on, steady progress was made. Under the direction of designer N. B. Chelomy, the power output of the Nene was progressively stepped up from 4500 lb static thrust to its 1951 rating of 5500 lb. High-speed fighters, such as the MiG-15 and La-17, are powered by M-45 units, as they are designated, and operations in Korea suggest that these Russian turbojets are extremely efficient under combat conditions. Reliable reports indicate that the M-45 is now being modified to obtain 6000–6500 lb static thrust, and new versions will be in production soon.

During the period when the centrifugal-type Rolls-Royce engines were being delivered, Russia had already been working for three years to design and produce German axial-flow units using the captured BMW 003A-2 and the Jumo 004B-4 as a basis for developments. Redesignated M-003E and M-004H, they had their power output increased from 1760 lb and 1980 lb thrust, to 3750 lb and 4000 lb, respectively. Early Red aircraft powered by these turbojets provided Stalin's air force with a much-needed morale booster at a period when other nations were forging ahead with jet propulsion. Present production is now concentrated on the M-012 (6600 lb thrust), and the M-018 (8000 lb thrust), two of the most powerful turbojets in the world, according to Mr. Morton.

In the field of rocket power plants, Russian designers have made further use of German data by producing a development of the Walter HWK 509C liquid-fuel rocket (rated at 4400 lb static thrust in 1945) which powered the Junkers Ju-8-248, an improved version of the Messerschmitt Me-164 tailless fighter of World War II. With an aggregate thrust of something like 6600 lb, the Soviet "rocketjet" has been under test for some time in the Yak-21, a diminutive experimental interceptor-fighter of obvious German parentage.

Soviet designers would appear to be giving the highest priority to thrust augmentation for their current-production turbojets. For a time, long afterburners were not favored by the USSR, but several high-speed sweptwing jets seen at the annual Moscow air display at Tushino airport in July of last year, would indicate a complete reversal of policy.

Liquid-fuel rocket assisters have not been neglected, and future Soviet developments of the 2500-lb thrust German BMW 718 should compare favorably with the new British Armstrong Siddeley Snarler and other Allied units.

Thus it can be seen that Russia's present policy is to concentrate on three main types of turbojet, namely, the M-45, the M-012 and M-018, together with various forms of augmentation to increase available power output.

It is reassuring, however, to remember that the downfall of Germany's Luftwaffe came from overstandardization of equipment.

Production jets of the Red Air Force as covered by Mr. Morton, are as follows:

Designed jointly by Artem I. Mikoyan and Mikhail I. Gurevich, the MiG-9 was a direct development of the early MiG-7, and had the honor of being the first series-production jet aircraft to go into service with the Soviet Air Force, in 1945. Its meager performance with two M-003 axial turbojets of about 2000 lb static thrust each soon resulted in production being tapered off in favor of the single-engined Yak-15 fighter. MiG-9's, however, are still in service in small numbers with the East German and other satellite air forces.

The MiG-15, introduced in 1947, first gained notoriety in Korea, when its astonishing rate-of-climb and high maximum speed gave United Nation's pilots many a headache until the F-86 Sabre was introduced.

In general, the MiG-15 is considered a better all-round aircraft than the Sabre, and, like most other modern fighters of the Soviet Air Force, carries large-caliber cannon as standard equipment. Meanwhile, the RAF and the USAF still cling to 20-mm and 0.5-in. weapons of World War II vintage, long outdated by the rapid advances in air armament during the past six years.

Another strategic-area defender is the Yak-21, of 1948 vintage, and the postwar Russian version of the German Me-163 and Ju-8-248 rocket interceptors. With its HWK-509C development, this sweptwing fighter is said to be capable of speeds up to 900 mph for short periods. It is believed to be in limited production.

Semyon A. Lavochkin's La-15, also a 1948 model, is roughly the equivalent of the CF-100 fighter. It owes its basic design work to German World War II designer, Willy Messerschmitt. His Me-262 "Sturmvogel" was designated the La-13 by the Soviet Union, and put into limited production. A modified version known as the La-15, and fitted with Russian-built M-004 axial turbojets, followed. Latest production night-fighter variants incorporate sweptback wing and tail surfaces, and are powered by two 6600-lb static thrust M-012H engines.

Most recently reported armament are two 32-mm cannon and two 12.7 machines guns, the attack-escort fighter version carrying an all-cannon battery in the nose.

Pilots over Korea are rumored to have sighted a machine similar to the La-15 but no official confirmation of this fact can be obtained.

Rising production inside Russia itself indicates that this aircraft will form the nucleus of the USSR's night-defense organization.

Big Russian surprise of 1951 was the introduction of the MiG-19, a new fighter bearing a close resemblance to the German Tank-designed Ta-183 of World War II. It is likely that the MiG-19 was one of the high-speed "all-swept" jets shown at the July, 1951, Moscow air display.

Like the MiG-15, the La-17 was based on the German Focke-Wulf Ta-183/11, an advanced fighter designed in 1944 by Kurt Tank, currently working in Argentina. Experience gained in squadron service made the Soviet air force cut back production in favor of the more controllable MiG-15. Many La-17's are still in service, and radar "snoots" have been noticed on some versions flying in Germany.

Similar in layout to the MiG-9, the Yak-15 is another early piston aircraft rework of about the same period (1945). The 4000-lb thrust M-004H axial turbojet exhausted under the fuselage causing the loss of many tailwheels in early versions. This design defect was remedied by fitting a tricycle undercarriage.

Numerous variants of this little fighter have appeared, including a two-seat jet conversion trainer after the style of the Canadair-built Lockheed T-33. Production of the Yak-15 is now believed to be complete.

Latest Soviet tactical bomber in quantity production is the 580-mph Il-24, more commonly designated the Tu-10. Comparable in size to Britain's English-Electric Canberra, latest variants of the Il-24 are reported to be fitted with Shvetzov-developed M-018 axial turbojets. With afterburner fitted, a static thrust of about 7700 lb is attained for each unit. Early bomber and trainer versions were powered by two Chelomy-Nenes (M-45's) of over 6500 lb static thrust each.

Reputed to be the fastest and best Red sweptwing fighter, the Yak-25 is now entering quantity production, and soon may be the standard first-line offensive and defensive weapon of the Soviet Union.

Unconfirmed reports from Korea state that the Yak-25 is of conventional design and uses a liquid-fuel rocketjet for increased thrust.

Tentatively designated the La-26, this latest Soviet medium bomber is at present in the process of being delivered to operational units. Aerodynamically similar to the USAF B-26 Marauder, the La-26 is reputed to be Russia's short-range atom carrier. Naval units are also interested in this type as torpedo-bomber replacement for the piston-engined Il-4. Sergei Vladimirovich Ilyushin's experience in this field might be a corroboratory factor for the designation Il-26, quoted by some observers.

Jet-Engine Center

TOP military and defense production officials and leaders of the aviation industry, state, and local governments participated on March 18 and 19, in the observance of the 10th birthday of the nation's first jet engine. As part of the ceremonies, the new jet-engine center which the General Electric Company is constructing at Lockland, Ohio, was dedicated in commemoration of "the fastest 10 years in aviation history."

It was only ten years ago, March 18, 1942, that America's first turbojet was completed and placed on test at G-E's Lynn, Mass., plant. This first engine, the I-A, was based upon designs of Britain's Whittle engine. The company followed this with designs of its own which resulted in such turbojet power plants as the I-16, J-33, J-35, and J-47. The J-47, some models of which provide more than 5800 lb of thrust, is one of the top production engines for the Air Force and powers such top planes as the North American F-86 Sabre, the six-jet Boeing B-47 Stratojet bomber, the North American B-45 bomber, the North American F-86D interceptor, the three-jet Martin XB-51 bomber, the Republic XF-91 interceptor, and the Convair B-36D intercontinental bomber which has four jets in addition to six piston engines.

On March 19, G-E delivered to the Air Force the 10,145th jet engine the company has produced. At the same time an advanced model jet engine which will make the North American F-86 even more potent than the Sabrejets now flying in Korea is in production for the U. S. Air Force, the company disclosed. Identified as the J-47-GE-27, the engine provides 10 per cent more thrust or driving force than the G-E power plants of the Sabres in Korea.

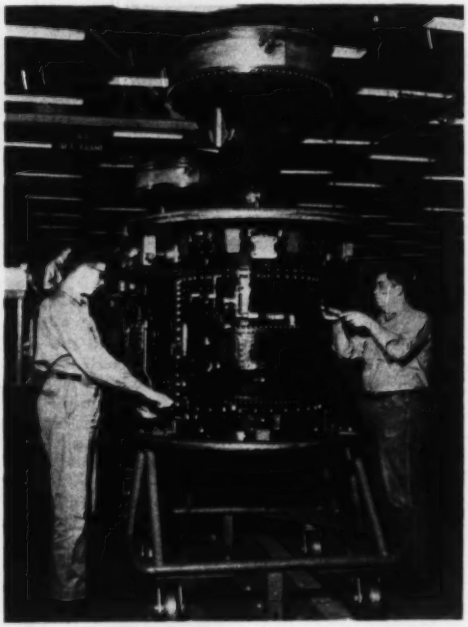

FIG. 8 DURING EARLY STAGES OF TURBOJET ASSEMBLY, WORKMEN ARE SHOWN TIGHTENING COMPRESSOR CASING BOLTS

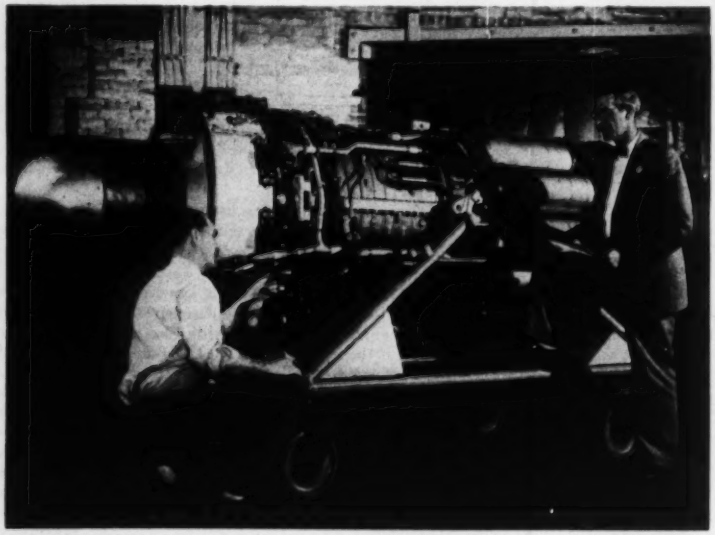

FIG. 7 G-E ENGINEERS INSPECT ADVANCED MODEL JET ENGINE, THE J-47-GE-27, WHICH THE COMPANY IS PRODUCING FOR THE AIR FORCE

A G-E engine of the same advanced rating will power the Navy's sweptwing fighter, the North American FJ-2 Fury. Like the J-47-GE-27, the Navy engine has a thrust rating in excess of 5800 lb compared to the more than 5200 lb previously announced for earlier models.

COMPONENTS MANUFACTURE

The new facilities at Lockland, which were inspected by those in attendance, are designed for precision manufacture of turbojet-engine parts on a production basis.

Part of the company's jet center, the new components manufacturing building, includes numerous machines especially designed to manufacture precision parts.

As an example of the high-

precision tools installed in the new facilities, is a Swiss-built Reishauer machine which grinds jet-engine gear teeth entirely automatically, to extremely fine tolerances.

A unique characteristic of the Reishauer machine is that its grinding wheel can grind 35 gears before redressing or resurfacing; wheels on other grinders must be redressed twice per gear. This results in a large timesaving.

Many other American-made tools which perform similar timesaving functions have been installed, as a result of G-E planners working closely with designers representing machine-tool firms throughout the country and nearby Cincinnati.

Parts production is headquartered in the modern new factory building erected by the company as part of the center. Service tunnels connect the new administration building, the parts building, and the engine development building.

JET-ENGINE ASSEMBLY

The process of assembling jet engines vertically, rather than horizontally, was also demonstrated to visitors.

FIG. 9 THIS CELL FOR TESTING NEW DEVELOPMENTAL AIRCRAFT JET ENGINES AT G-E'S LOCKLAND JET CENTER IS CAPABLE OF HOUSING TURBOJETS FAR MORE POWERFUL THAN ANY NOW IN PRODUCTION

Assembly of turbojets in an upright position was instituted in the company's Lynn, Mass., plant and has been adopted at Lockland on a large scale.

Vertical assembly of engines eliminates the very small sag which takes place when the 12-ft-long jets are assembled horizontally. As a result, better alignment is obtained between rotating and stationary parts.

Other advantages of the vertical-assembly process include the following:

1 Spacesaving. Three engines can be assembled in the space taken by two horizontally assembled engines.

2 Faster assembly. Working space is more accessible, more men can work on one engine, and the engine need not be rotated to reach working areas as is necessary with horizontal assembly.

At present the vertical method is used on the "green" or preliminary build-up assembly line but will be extended to final assembly lines as soon as possible. G. E. instituted the process on the green lines, for once an engine has been run, and parts have become "seated," the alignment problem is not as serious. After green assembly, jet engines are tested and then completely disassembled for inspection before reassembly and final test.

As the engine is built up vertically, that portion of the engine on which the assemblers are working is made readily accessible. The build-up is entirely vertical until the final stage of assembly, when the jet is turned on its side to receive the tail cone and accessories which go into the nose section. Eventually, the entire operation will be vertical, including shipment.

JET-ENGINE TEST CELLS

Test cells designed to withstand the searing blasts of jet engines much more powerful than any now in production were inspected by the visitors.

Capable of containing the fiery heat of aircraft turbojet exhausts, which even now send cell exhaust temperatures to 1000 F in eight seconds, the cells also have special sound-muffling features which greatly reduce the sound levels of engines being tested preparatory to delivery. Reduction of the sound below normal levels was placed at 50 per cent. The materials used are a mixture of special cement and artificial aggregate consisting of volcanic ash and a filler of hard shale.

An experimental cell was tested at the company's Lynn, Mass., River Works and served as the model for the 33 test stands constructed at Lockland to meet increased Air Force engine requirements.

Control rooms are completely isolated from the cells. The cells, including exhaust stacks, are 114 ft long. Air enters the engine at 100 mph and exhausts at 1300 to 2000 mph. From the engine it is directed to a cylindrical "augmenter" which carries the exhaust gases to the stacks.

The cells are equipped with carbon-dioxide systems which can immediately flood the engine test area in case of fire. Pressure-relief hatches are provided in all areas where necessary.

Exhaust stacks were precast in sections, with eight 25-ton sections making up each stack. The cell air inlet, and the cell itself, were poured in place in the conventional manner.

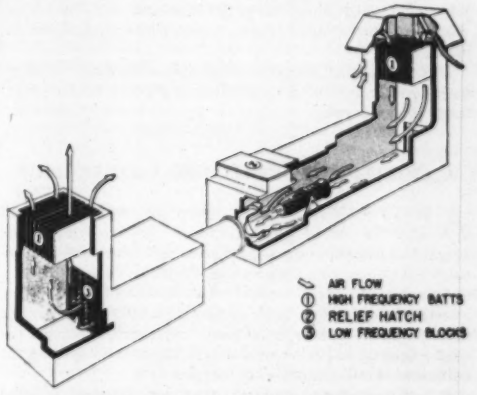

FIG. 10 CUTAWAY DRAWING OF TURBOJET-ENGINE TEST CELL SHOWS THE AIR FLOW AND THE SYSTEM OF BLOCKS AND GRIDLIKE "BATTS" DESIGNED TO LOWER THE SOUND LEVEL OF ENGINES UNDER TEST

FIG. 11 INSIDE FLOATING CONTROL ROOM AT LOCKLAND JET CENTER, INSTRUMENTS RECORD EVERY PHASE OF A TURBOJET ENGINE'S PERFORMANCE UNDER TEST

(Suspension of the room on rubber and cushioning it by air from the adjoining jet-engine test cells reduces sound and minimizes possibilities of instrument error through vibration.)

Data taken in engine tests include fuel flow, oil flow, air flow, thrust, pressures and temperatures, and speed of rotating engine parts.

New Jet Engine

THE Navy Bureau of Aeronautics has announced the completion of initial tests on a new and more powerful jet engine to power its latest fighter aircraft.

The engine is an advanced version of the J-48 Turbo-Wasp built by Pratt & Whitney Aircraft in East Hartford, Conn. The new J-48 passed its preflight tests and is scheduled for immediate flight test. It will be in production this fall.

This latest version of the J-48 uses a new heat-resisting alloy which contributes materially to increased performance and saves substantially on critical metals now in short supply. The engine delivers a great deal more thrust than the previous J-48 model which is rated at 6250 lb static thrust. Further development of this engine to even higher power ratings is anticipated.

This power plant represents five years of intensive development by the Navy and Pratt & Whitney Aircraft on centrifugal flow-type jet engines.

Compact Electronic Computer

A DATA-HANDLING and computing system, patterned after the famed giant electronic "brains," but more adapted to modern business needs, has been developed by Consolidated Engineering Corporation, Pasadena, Calif.

According to the company, the data-handling and computing system initially will be made available for military uses in the fields of guided missiles, wind-tunnel experimentation, and jet-engine testing, and other similar-type operations requiring the collection of millions of bits of complex data.

It was pointed out, however, that the equipment is being developed primarily for the businessman who deals with a large volume of figures. With it he can be his own brain trust, cutting the number of man-hours required to solve his involved problems to a small fraction of what it is today.

The new system will be used extensively for factory-production control, billings and inventory control for large department stores, bank accounting, public-utilities billings, insurance-company data, large test-stand operations on machines of all types, and preliminary engineering figures for much of the complicated equipment now being built.

Pilot models of the new equipment have already been built and development operations are expected to be completed in the not-too-distant future.

The system is composed of two instruments—the data handling and recording equipment and the computer.

To meet the varying needs of business and industry, the company is developing two data-handling and recording instruments, both to be used in conjunction with the same computer. The first of these is called the Sadic. This instrument is an extremely high-precision but relatively low-speed analog-to-digital converter (converts data into special arithmetical terms which are then fed into the computer). The second is the Millisadic which operates at phenomenally high speeds but which does not carry the converted data to as many decimal places as the Sadic.

The Sadic will be used where data comes in at a comparatively slow rate. The Millisadic, on the other hand, can handle 1000 signals per sec or 3,600,000 an hour, storing them on a magnetic tape. To achieve still greater speeds, the instruments can be combined into multiple systems.

The company's electronic digital computer, the other half of the system, will be a general computer but especially adaptable for use in the computation of the data collected by the Sadic and Millisadic.

This device, it is reported, will take seconds to supply answers dozens of men would have labored over for days. It will handle up to 16 decimals and complete 1000 additions per sec.

Finding space for the system will be no problem, because the computer is about the size of a desk while the Sadic and Millisadic are about as large as a 6-ft man.

Radiation Laboratory

THE largest source of radioactivity outside of AEC installations will be available for research in industrial uses of atomic and nuclear science when Stanford Research Institute of Stanford, Calif., opens its new Radiation Engineering Laboratory.

Dr. J. E. Hobson, SRI's director, said that the Institute has completed arrangements for obtaining a 5000-curie source of Cobalt 60, a gamma-ray emitter, from Brookhaven National Laboratory.

By curie measurement (the rate of atomic disintegrations per second), emissions from a 5000-curie source are so powerfully penetrating that they could be partly duplicated only by about $100 million worth of radium.

SRI's radioactive source will be five times the power of any presently available for industrial and medical research.

The new Radiation Engineering Laboratory, due to start operation in late spring, will develop and engineer practical safe systems for the use of large amounts of radiations in a wide variety of possible industrial applications.

Some of the promising uses to be investigated at an early date include nondestructive testing of metal castings and parts by radiography and the cold sterilization of heat-sensitive foods and drugs using penetrating gamma radiation.

Companies wishing to explore uses of radiation for their processes or products may bring samples to the laboratory for irradiation at a specified intensity and duration. The samples may then be returned to the company for analysis and study.

The Institute will undertake experimental work using radioisotopes. Tracer techniques will be studied as a means of reducing the time and expense of complicated research problems.

Although the Cobalt 60 source is a high level of radioactivity, it represents no safety hazard inasmuch as it will remain at all times in an underground water-filled tank. Protective devices, remote-control equipment, and carefully controlled conditions for experimentation have been designed into the engineering system.

Laboratories have been blueprinted for high, medium, and low levels of radioactivity for experimentation using radioisotopes. The new facility will contain a general-purpose pilot plant. Counting rooms, instrumentation, photographic facilities, storage vaults, and other required utilities will be included.

The Radiation Engineering Laboratory will be a part of the Institute's Applied Physics Department, Dr. Hobson announced. It will be staffed with its own specialists.

Atomic Calendar

AN "atomic calendar," based on Carbon 14 that enables scientists to determine the age of objects as old as 20,000 years, was described recently by Edward Deevey, Jr., associate professor of biology and director of the Yale Geochronometric Laboratory where tests with Carbon 14 are being conducted. He said that scientists now for the first time have an accurate method of dating such events as the melting of the great ice sheets and the origin of agriculture.

The method is based on the discovery by Willard Libby of the University of Chicago, that natural carbon is radioactive. Carbon 14, the radioactive form of carbon, occurs in animals and plants, and after their death disintegrates at a steady rate.

Since the rate of disintegration is known, scientists can measure the age of a fossil as well as the geologic or archeologic event that led to its preservation, according to Mr. Deevey.

Carbon 14 tests at Chicago have already verified past estimates by archeologists of the age of various fossils. Wood from Egyptian tombs estimated at about 4500 years have proved to be that age when tested by radiocarbon.

He explained that wood from giant redwood trees shown by tree rings to be 3000 years old, also was verified at 3000 years when tested in the Chicago laboratory.

In another test, mud samples from several geologic levels of a boggy Connecticut pond indicated that the beech and hemlock forests in the state today began about 8800 years ago. The forest produced recognizable pollen grains that were blown into the pond and subsequently buried in the mud by younger deposits.

Although more than 300 radiocarbon dates have been measured at Chicago, Mr. Deevey pointed out that dating the past still presents many difficulties for the scientist. Yale's Geochronometric Laboratory, established in 1951, is mainly devoted to solving some of these problems.

Coal Gasification

TWO international scientific conferences just held in this country promise to benefit not only the European nations represented, but also the people of the United States, according to Secretary of the Interior Oscar L. Chapman.

The Secretary was referring to the First International Conference on Underground Coal Gasification at Birmingham, Ala., and the symposium on coal gasification subsequently held in New York in connection with the meeting of the American Institute of Mining and Metallurgical Engineers. The Bureau of Mines assisted in arranging both of these gatherings, the first in co-operation with the Alabama Power Company, and the second in co-operation with the Coal Division of the AIME.

The presence of European scientists and technologists who participated in the two gatherings was made possible by the Mutual Security Agency.

The two sessions formed the high point thus far of co-operation between scientists and technologists of the Bureau of Mines and those of several European countries in studying the direct gasification of coal, both above ground and in the seam in which it occurs. They resulted in the following conclusions, Secretary Chapman pointed out:

1 The growing demand for gas, gasoline, and chemicals has called widespread attention to the approaching need for using coal as a raw material for these products. Direct gasification, as opposed to processes in which coal is coked before gasification, is one of the most important steps in obtaining such products from coal.

2 Huge resources of low-rank coals and lignites, which cannot now be exploited economically by standard techniques, are available for direct gasification.

3 High efficiency, through large-capacity equipment for the gasification of coal, won by standard mining methods is being developed in the United States and in Europe. It has been demonstrated that operating under atmospheric pressure and at 30 atm is entirely feasible.

4 Experiments on underground gasification of coal in the bed have been carried out in Belgium, French Morocco, Italy, the United Kingdom, and the United States, using air. Large scale-model experiments using oxygen and steam have been carried out in Belgium. These experiments have yielded both practical and fundamental scientific knowledge. The exchange of information on this work at Birmingham and New York has been extremely useful.

5 A program of further systematic experimentation in Belgium, French Morocco, the United Kingdom, and the United States has been developed. This program, offering considerable promise, includes experiments with (*a*) the percolation system using electric, hydraulic, and pneumatic methods for connecting the vertical boreholes, thus avoiding the construction of underground tunnels; (*b*) the classical stream method in which preheated air is blown at high velocity through a prepared passage; and (*c*) a process using parallel passages opened along the pitch of the bed and unidirectional flow of oxygen and steam.

6 The several systems mentioned are adaptable to a wide range of geological conditions and purposes. Their common aim is to produce gas at low cost with either air or oxygen, depending upon the type of gas required. The combined results from all the countries indicated that this is feasible.

7 Successful development of these processes may eventually reduce underground work, increase productivity, and open to economic access sources of energy previously unexploitable. This will open new employment opportunities. Both the underground and above-ground processes will make the world's large coal reserves a basic commodity for meeting ever-increasing demands for liquid and gaseous fuels.

8 The social and economic importance of this research can hardly be overestimated. For instance, Europe's coal budget is around $6 billion a year, including imports. When eventually developed for commercial application, underground gasification may save a considerable part of this budget as well as give the flexibility necessary for adapting production to fluctuating needs. Similarly, although under different conditions, the United States will benefit from the availability of new methods for exploiting fuel resources.

9 The consensus of the First International Conference on

Underground Gasification was that public authorities and private enterprise should be encouraged to support this research program by all available means and to carry it out with as little delay as possible.

10 The co-operation which has been developing gradually among the several research centers and which finally brought about the First International Conference on Underground Gasification should be continued and a second conference held in two years in Europe.

Air Conditioning

DEVELOPMENT of a unique cooling and air-conditioning system, allowing workmen to operate amid a concentration of temperatures exceeding 2000 F in the making of Fiberglas yarn, is announced by Carrier Corporation, Syracuse, N. Y.

The installation of the system has been made in a plant recently completed by Owens-Corning Fiberglas Corporation at Anderson, S. C., which is now producing Fiberglas yarns currently in high demand in the defense effort.

Principal uses of the glass yarns produced there are in the reinforcement of plastics, industrial papers and tapes, and mechanical rubber products; in vinyl and rubber-coated fabrics; as an electric insulation base material; and for decorative fabrics.

With temperatures well above 2000 F usually employed, the air-conditioning system maintains the uniform temperature and humidity conditions required for comfort and conformity with manufacturing specifications.

Thoroughly tested in an elaborate pilot-plant operation, the new Carrier system holds temperatures to a maximum of 80 F, and eliminates more than 90 per cent of the heat radiations in the area surrounded on three sides by the furnace. A number of furnaces, grouped in a single area, combine the making of molten glass from the raw ingredients, and manufacture of the glass filaments, thus simplifying production of the yarns.

The filaments are drawn through tiny orifices in bushings which are maintained at a constant temperature above 2000 F. Temperatures of other surfaces surrounding the working aisles range from 350 to 650 F.

The Carrier system combines radiant panel cooling with distribution of completely conditioned air. This is the first such installation of its kind, Carrier officials stated, but is believed to be adaptable to other industrial applications.

As designed for the new Anderson plant, radiant cooling panels shield the working aisles from the melting tanks and the forehearths. These panels will cut off the heat radiations and handle about 70 per cent of the cooling. The panels are made of two thin sheets of steel welded together, with one of the sheets embossed to provide water circuits within the panel.

The additional air-conditioning system necessary to establish the specified 80 F and 50 per cent relative humidity supplies air through specially designed continuous-slot pan-type outlets. Air emerges from a slot in a duct running the length of the aisle, and is deflected into a diffuse stream.

The fabricating area in the new plant, an extensive finishing room where the yarns will be further processed, together with the plant offices, shops, cafeteria, and first-aid rooms are also completely air-conditioned.

Refrigeration for the air conditioning is provided by two Carrier centrifugal refrigeration machines with a combined cooling capacity of 1000 tons. The radiant cooling panels and the refrigeration-machine condensers are supplied with water recirculated through a spray pond to be located adjacent to the plant. The water enters the cooling panels at a maximum of 85 F and leaves at 100 F. Total cooling provided by both the panels and the air-conditioning system is about 1350 tons.

Conservation of Manpower, Materials

(Continued from page 391)

much of their company's time doing needless work, and are perhaps missing many bets.

Improve Estimating Habits. An unpleasant duty of most engineers is cost estimation. They can reduce their pain and use of time greatly if they will help the accountants to design realistic cost statements, as earlier discussed. Another help in routine work is to get the habit of estimating in terms of assembled units, instead of each time pricing the long lists of flanges, bolts, and nipples. One is less likely to underestimate if he visualizes the whole project before starting to cost its elements. My personal peeve is the engineer who underestimates his jobs by forgetting whole essential units, and who remains nonchalant about it.

Get Help for Routine. Many men well qualified to plan, lay out and direct work, like to donkey through listing and calculating jobs that can be done by nonprofessionals. (Others must do it by force of circumstance.) By obtaining junior help, considerably more senior ability will be conserved for other pressing work demanding senior experience and skill.

Avoid Overspecializing. Outside the laboratory, management perhaps is overdoing employment of specialists. We need more men like our hardy forebears who learned a better-than-average smattering of electrical and civil engineering as well as mechanical—and often had some exposure to chemical. Why shouldn't management conserve engineer power by hiring several such abilities under one hat? A fine article[1] addressed to readers, suggesting that they should avoid overspecialization, was published recently.

Avoid the Mumble-Jumble. Many technologists will never become engineers until they learn to analyze and present the practical economics of their applied technology. They still are paying for their college defections. They avoided Adam Smith like the plague; thus their economic thinking is in a jumble. Now they must plague their associates to make the cost analyses needed to get cash to put their ideas into effect. And those who also avoided English composition usually write as well as talk in technical gobble-de-gook. These fellows are double plagues because they mumble while they jumble!

Learn to Write Better Reports. Let's shed a tear for the conscientious one whose boss—or perhaps his boss's boss—in the end always has to milk him for all the facts, and then recompose his report before it has the needed sales appeal. But the mumble-jumble, if unaware of his mental and verbal halitosis, is more to be pitied than censured. In one way or another his best friends should tell him, and teach him how to organize economic as well as technical data, and how to present them in simple terms.

> Dear Alma Mater: Give us more engineers who can transcend the technical job of appraising needs and making layouts; yes, and the economic job of estimating capital costs versus operating savings. Give us men who also can do the composition job of wrapping it up in succinct reports that will sell management on the projects.

Proud indeed must be the engineer who can hand his boss reports that are sent on with but short notes of endorsement. His name becomes favorably familiar upstairs, even to the directors. (And that's not bad when salaries are being reviewed.) Here is the engineer who—by saving the energy of his fellow managers—is conserving manpower vital to industry's success.

[1] "Take a Broad View of the Scope of Your Profession," by A. P. Adamson, MECHANICAL ENGINEERING, vol. 73, 1951, pp. 649-650.

ASME TECHNICAL DIGEST

Substance in Brief of Papers Presented at ASME Meetings

Aviation—Heat Transfer

Friction Surfaces for Spin-Up Simulation in Landing-Gear Drop Tests, by D. W. Drake, Jun. ASME, Lockheed Aircraft Corporation, Burbank, Calif. 1952 ASME Spring Meeting paper No. 52—S-1 (in type; to be published in Trans. ASME.)

CURRENT procedures for drop-testing of landing gears entail the simulation of wheel spin-up. The use of a fixed reaction surface in conjunction with spinning wheels in the drop tower introduces friction conditions between the tire and reaction surface that do not permit direct use of airport surfaces such as concrete. For this reason the "coefficients of friction" of a number of reaction surfaces have been evaluated and their value for spin-up simulation is discussed.

Concrete was found to be unsatisfactory as a friction surface for wheel spin-up simulation in drop testing. The information currently available suggests that a coefficient of friction of 0.5 to 0.6 is of the right order for large (over 30 in.) diameter, normal pressure (under 150 psi) tires. Small high-pressure tires develop significantly smaller coefficients of friction under similar conditions than the larger normal pressure tires.

Using special steel surfaces, desired coefficients of friction can be developed in drop tests. At present, the proper friction surface for a given landing gear must be selected experimentally.

Flight-test information relative to the friction developed in the spin-up of small high-pressure tires is needed in order to drop-test such landing-gear installations adequately.

Dynamic Buckling of Thin Elastic Plates, by G. A. Zizicas, University of California, Los Angeles, Calif. 1952 ASME Spring Meeting paper No. 52—S-3 (in type; to be published in Trans. ASME).

THE behavior of thin elastic plates under loading parallel to their middle plane, constant or arbitrarily varying with time, is considered. The effect of vibrations in the middle plane is examined. In the transverse direction it is shown that by introducing appropriate nondimensional variables and parameters the time dependence reduces to the same type of equation as in the case of columns. Thus the fundamental features of plates and columns are similar. Additional discussion and examples of the solution of the nondimensional equation are presented. Higher modes are related to the fundamental mode of the same plate under appropriate different loading. The need of considering the entire time history of the loading is shown by examples. Shear loading and various boundary conditions are discussed. For loading constant during the time of application initially curved and eccentrically loaded plates are proved equivalent models for the investigation. A slight modification is necessary for a load arbitrarily varying with time.

Pressures Required for Thin Press Forgings, by William Schroeder, Mem. ASME, 1952 ASME Spring Meeting paper No. 52—S-4 (mimeographed).

ONE goal of the aircraft designer is to make large airframe components as a unit. A step in this direction will result when the conventional skin and stiffener structure can be replaced with a structurally efficient thin forging with integral stiffening elements.

The forging of thin sections has in the past been impractical for the reasons that forging presses had insufficient capacity and forging hammers were not adapted. However, with the recent installation of an 18,000-ton forging press and even larger presses in the design stage, new but unexplored possibilities for producing such parts have arisen.

Equations for estimating the pressure required for forging thin-skinned parts with parallel trapezoidal stiffeners are derived and expressed in terms of the part dimensions, the coefficient of friction, and flow stress of the metal. Since a number of simplifying assumptions have been made in the analysis and some effects have been omitted entirely, the formulas must be considered as approximations only. Despite these approximations, moderately accurate agreement has been found with actual forging pressure required where a comparison has been possible.

Aside from the value for computing

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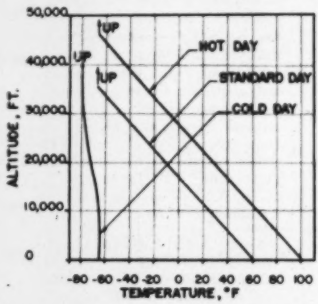
pressures, the formulas can serve as a useful guide to establishing the relative importance of the various parts parameters, flow stress, and coefficient of friction. As presented, the equations express relationships between nondimensional ratios; and a single computation provides a value for an entire family of parts with the same nondimensional ratio.

A New Method of Performance Analysis of Air-Cycle Cooling of a High-Speed Airplane, by Donald E. Brimley, Douglas Aircraft Company, Santa Monica, Calif. 1952 ASME Spring Meeting paper No. 52—S-5 (mimeographed).

THIS paper considers some of the problems involved in the performance analysis of an air-conditioning system applied to a particular high-speed single-seat airplane and evaluates specific air-



STANDARD TEMPERATURES VS. ALTITUDE

cycle-system equations by methods generally applicable to all types of high-speed airplanes. Specific values of some of the quantities in the analysis have been omitted to comply with security regulations, but qualitative values are shown in an attempt to present a complete picture of the design problems

Some of the design conditions which are independent of the air-conditioning system and which must be known before proceeding with the performance analysis are: (1) Ambient temperature range in which the airplane is to be operated, (2) operational pressure altitudes, (3) humidity conditions, (4) envelope of steady-state flight speeds, (5) stagnation air temperatures, (6) skin temperatures, (7) inlet and exit coolant-air pressures, (8) engine-compressor discharge pressures, (9) engine-compressor discharge temperatures, (10) cabin pressures, (11) cabin leakage rates, (12) endurance of the airplane, (13) number of passengers, items, to be cooled or heated, (14) general space configuration, and (15) ground air requirements.

An air-cycle machine to produce the refrigeration and heating required is described. Equations determining the performance of the air-cycle machine are developed and solution by means of digital computing machines is described.

University of California's New Aeronautics Facilities, by Earl Janssen, Jun. ASME, University of California, Los Angeles, Calif. 1952 ASME Spring Meeting paper No. 52—S-6 (mimeographed).

THE present importance of the aircraft and related industries to the economic life of the West and to the security of the nation, provides a challenge to the schools of engineering in this part of the country. Their traditional functions of instruction and basic research must be at a level to complement the production, development, and operations activities of these industries if this challenge is to be met.

Toward this end the University of California has established certain aeronautics facilities as part of the facilities of the College of Engineering on the Los Angeles campus. These new facilities provide specifically for instruction and research in the areas of aerodynamics, propulsion, and structures. They are housed for the most part in the new Engineering Building just completed in the spring of last year. In the planning of the aeronautics facilities (and of the general program in aeronautics of which they are a part), the following were the guiding considerations:

1 The new facilities should fit into, and be a part of, the instructional activities, the graduate research program, and the contract research program of the College of Engineering.

2 They should, in part from the standpoint of type of equipment, and in part from the standpoint of type of research emphasized, complement rather than duplicate the facilities of the other schools in engineering in this area.

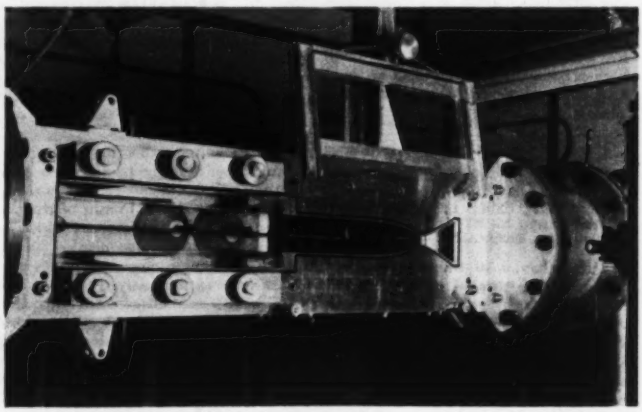
3 They should be available to other institutions, government agencies, and private concerns in accordance with the service-to-industry policy of the University.

These considerations continue to serve as a guide now that the facilities are established and in operation.

Use of Honeycomb Panel Construction in Military Lightweight Trailers, by B. Del Mar, Mem. ASME, and H. Stumpf, Del Mar Engineering Laboratory, Los Angeles, Calif. 1952 ASME Spring Meeting paper No. 52—S-7 (mimeographed).

THIS paper describes certain design requirements for military van-type trailers, and the advantages and limitations of honeycomb-core panel-type constructions for these vehicles.

The constant search for stronger lighter structural materials and construction methods has focused considerable attention on the possibilities of honeycomb-core structural panels. Panels incorporating a lightweight core, separating and bonded to thin high-strength facing materials, are structural units with very high strength-weight and rigidity-weight ratios. Such panels, with their neat appearance, insulation properties, and simplicity of assembly are suitable to many applications in the design of air-borne equipment. One such application is in the design of van-type trailers which are required to house elec-



SUPERSONIC WIND TUNNEL FOR MACH NUMBERS 1–5 AT UCLA AERONAUTICS FACILITIES

PAPER HONEYCOMB CORE WITH ALUMINUM-ALLOY FACES

tronic equipment and the necessary operating personnel. Such vehicles may be required to house ground control equipment used for directing aircraft or missiles or for the detecting and tracking of targets. The operational requirements imposed by such specifically designed equipment can seldom be satisfied if contained in "stock" vehicles. The special requirements associated with the successful operation of this equipment will often indicate the necessity of a specific van trailer design and such design may incorporate honeycomb-core panels to good advantage. In this paper a number of the possible design requirements will be weighed against the particular characteristics of honeycomb-core panel-type construction.

Of all of the so-called "sandwich-construction" panels, those incorporating a manufactured honeycomb-core material appear to be the most promising. Honeycomb-core materials are manufactured from thin sheets into a bulk assembly of uniform structural shapes capable of withstanding shear and compression loads. Most of these have been hexagonal in shape, resembling honeycomb cells. There are several core materials now being manufactured in quantity. Among these are 4-oz and 8-oz cotton-duck cloth; 60, 70, 110, and 125-lb Kraft paper; fiberglas cloth; and 0.002-0.006 aluminum foil. A number of other materials are being manufactured experimentally. These materials are manufactured into honeycomb cores having a variety of cell pitches, with $1/4$ and $7/16$ in. being the most common. The paper and cloth are impregnated with resin which is cured to hold the core shape. Panels can be fabricated by facing the core with metal, wood, plastic, cloth, or paper sheets. The facings can be bonded to the honeycomb with any one of a variety of commercially available resins. These core materials are available for any desired thickness of panels; however, the majority of design requirements have been met with panels less than five inches thick. This has dictated mass-production policies. The available mass-produced cores also are limited in length and width by existing production equipment. The core materials are produced in sizes considerably less than that of standard facing materials. Splicing of core segments, therefore, is required for their fabrication into panels.

Honeycomb-core material, when bonded into panels, is capable of working the face materials up to their yield strength. To do this the core carries shear loads, resists tension and compression loads perpendicular to the plane of the panel, and stabilizes the faces, preventing premature buckling.[2] For the higher-strength cores the bonding of the components of the panel is increasingly critical.

Wood Technology

Hardboard-Faced Fir Plywood: Production and Specifications, by John D. Ritchie, Douglas Fir Plywood Association, Tacoma, Wash. 1952 ASME Spring Meeting paper No. 52—S-11 (mimeographed).

HARDBOARD-FACED plywood is a promising development in the Douglas-fir plywood industry's effort to more completely utilize raw materials and to expand markets. It effects important savings in veneers and opens up many new use possibilities. It also fits in readily with plywood production. Success of the material depends greatly on an important first step—the establishment of industry specifications covering raw materials and manufacturing processes to assure a product of quality and uniformity throughout the industry.

Hardboard-faced plywood is a unique new panel material which combines a backbone of Douglas-fir plywood with the smooth tough surfaces of hardboard. It is made up of 5 or more plys including the two outer faces which are hardboard instead of conventional fir veneers. It is constructed in the same manner as fir plywood and is manufactured in exterior and interior types. Thicknesses are $1/2$, $5/8$, $3/4$ in. and heavier. Hardboard-faced plywood takes advantage of the strength, rigidity, split-proofness and large panel size of conventional plywood. Hardboards add a very smooth, uniform, wear-resistant surface.

This is a combination of two long-established products. It is new because for the first time hardboard and fir veneers have been combined in the process of manufacturing Douglas-fir plywood. Yet full advantage is taken of the production know-how of both the fir plywood manufacturer and the hardboard producer. From a marketing standpoint, which is all-important, this combination has already been demonstrated successfully in a number of uses. Hardboard and plywood have been put together by fabricators who have purchased the plywood and the hardboard separately. So, while a new product is being introduced, production and marketing experience essential to getting off on a sound basis is readily available.

Some Technical Aspects of Trimming Lumber in the Planing Mill, by Peter Koch, Mem. ASME, Stetson-Ross Machine Company, Seattle, Wash. 1952 ASME Spring Meeting paper No. 52—S-14 (mimeographed).

THIS paper discusses four classes of lumber trimming machines applicable to the planing mill. The classification is made according to function as follows: (1) Irregularity or defect removal to increase the value of the residual portion; (2) double end trimming to a length standard acceptable by the trade; (3) trimming to specified lengths of the higher grades of stock after it has been tied into bundles; and (4) end matching to random-length stock to permit fuller utilization of the shorter lengths.

The argument is offered that a finished piece of lumber is not completely ready for the market until the two ends as well as the four sides have been machined.

Generally, lumber is trimmed for one or more of several reasons, i.e., to better the grade, to decrease shipping charges through a saving in weight and space, to prepare the stock for subsequent end treating or distinctive end marking, to increase usability and hence salability because of accuracy of length trim, to increase utilization through end matching, and finally, to establish a uniform practice for pricing and selling purposes.

Hydraulic Barking, by L. E. Hill, Jr., Weyerhaeuser Timber Company, Everett, Wash. 1952 ASME Spring Meeting paper No. 52—S-15 (mimeographed).

HYDRAULIC barking is the operation of removing the bark from logs or remnants of logs such as slabs and edgings by means of high-velocity jets of water. The material which is treated is highly variable in size and shape. The benefits which have been obtained by this method of bark removal are listed. A brief description of the types of the most successful hydraulic log barkers is given, as well as mention of the installations that can be seen in the Pacific Northwest.

The elimination of bark by hand peeling is too expensive in all parts of the

world where labor costs are high. Alternatively, its removal by the use of power-driven cutterheads entails loss of wood when the wood is reduced to a size permitting this method of bark removal, and further loss when the cutterhead cuts below the surface of the wood. The losses attendant upon cutting whole logs to cants, and barking in power-driven concave-head planers has been measured with the following losses, in per cent of the original log: In the sawmill in reducing to size, 9.3 per cent; in the chipping plant, making chips, 9.8 per cent.

In addition to these losses of the valuable raw material, the labor cost of producing chips in the old-style chipping plant was far higher than that in a well-designed barking department.

Many of the newer installations are being made at sawmills, in such a location that the wood entering the mill has been cleaned of its bark. The following advantages are being realized from such an arrangement: the sawer has a better opportunity to judge his cutting procedure more efficiently; lighter-gage saws can be used with a reduction in kerf; wear and tear on saws, due to the gravel and dirt embedded in the bark, is almost completely eliminated; the mill can be kept cleaner with fewer men assigned to that work; mill operation is faster and with fewer conveyer jams; and finally, all of the material which cannot be used for lumber but which is sound wood can be made into chips for further production of pulp or board.

The hydraulic barker has found its greatest acceptance in the Pacific Northwest, and has been developed in its various designs to handle the range of sizes and shapes which are encountered in this area. Those barkers which are installed ahead of a sawmill must process the logs of maximum size and length which the mill can handle. This makes it necessary for the barker to handle pieces with diameter up to seven or eight feet, and length up to 55 ft. The other end of the range is found with the barkers used on salvage or farmer wood where the length may be as little as four feet, and the diameter as small as four inches. The variety of shapes of the logs is nearly as great.

Gas-Turbine Power

The Function of a Bootstrap G-T Unit in University Work, by Oliver Foss, North American Aircraft, Los Angeles, Calif., and Michael Guidon, Jun. ASME, University of Washington, Seattle, Wash. 1952 ASME Spring Meeting paper No. 52—S-8 (mimeographed).

TO help familiarize students with the turbojet, two years ago the University of Washington Mechanical Engineering School built a small research model as a part of their laboratory program. This unit was inexpensively built and has proved very successful both as a research and demonstration tool.

Reason for the name, "Bootstrap," which has been given this type of device, is as follows: At the time of the unit's construction, if a matched compressor and turbine with efficiencies of 100 per cent could have been obtained, a true Bootstrap Unit could have been built, that is, a gas turbine whose turbine drove the compressor that supplied the air to drive the turbine that drove the compressor that drove the turbine. Such an arrangement would, effectively, be lifting itself up by its own bootstraps.

But unfortunately, such units are unavailable. Therefore a combustion chamber was placed between the compressor and turbine of a surplus turbosupercharger and heat added to make up for the inefficiency losses. And, while the unit is called a Bootstrap Rig, it actually isn't. But regardless of this misnomer, this type of turbojet has proved very effective in the lab and at other schools and laboratories throughout the country. Similar units have been built and are running at Purdue University, at Oregon State College, and Lehigh University.

A turbosupercharger consists of two components—a centrifugal compressor used for supercharging a reciprocating aircraft engine and a turbine, which drives the compressor and is driven by the exhaust gases of the aircraft engine, Diesel engine, or other reciprocating prime mover. Thus the two major components of a turbojet are complete in a prepared package.

As a basis of comparison to the usual gas turbine, the air rate of this compressor is approximately 4 lb per sec at a pressure ratio of 2.4 and a maximum rpm of 24,000. The bearings are pressure-lubricated with regular aircraft hydraulic fluid. The turbine wheel is $12^1/_2$ in. in diam and has stellite buckets. The forged aluminum compressor impeller is 9 in. in diam.

This unit is mounted on a steel test stand with the axis of rotation parallel to the ground. A bellmouth is attached to the intake of the compressor to measure air rate. Leaving the compressor, the air is ducted to a straight-through, can-type combustion chamber which was designed and built at the University. The hot products of combustion are directed from the combustion chamber to the turbine nozzle box. The low-pressure gases leaving the turbine have their final expansion in a stainless-steel exhaust nozzle.

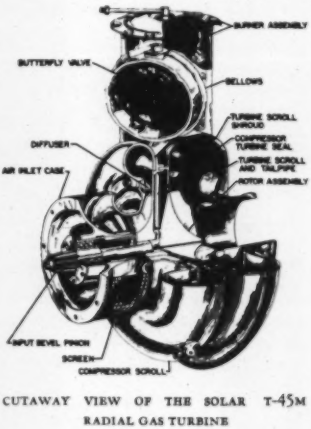
The combustion chamber is ignited by a 10,000-volt neon-sign transformer. Kerosene, which is the only fuel used, so far, is introduced into the combustion chamber through standard DeLaval oil-burner nozzles. Starting is accomplished by blowing air against the downstream side of the turbine wheel to bring the unit up to speed. The unit will start at any speed above 3500 rpm.

The entire test stand is hung on light steel cables and all controls and instrument leads are flexible. Motion due to thrust is restrained by a steel cantilever which has strain gages attached. These gages are calibrated to read the pounds of thrust developed.

Radial-Flow Compressors and Turbines for the Simple Small Gas Turbine, by L. R. Wosika, Solar Aircraft Company, San Diego, Calif. 1952 ASME Spring Meeting paper No. 52—S-13 (mimeographed; to be published in Trans. ASME).

IN 1948 the Bureau of Ships asked Solar to develop a compact, lightweight, 45-hp, Diesel-fuel-burning, portable gas-turbine-driven fire pump.

The Navy climaxed its specification



CUTAWAY VIEW OF THE SOLAR T-45M RADIAL GAS TURBINE

with a demand that the unit be started by hand cranking. This was an entirely new engineering problem on top of several other difficult specifications, such as low weight, small dimensional cubic package for portability, and compressor inlet temperatures above 120 F.

After a careful consideration of component arrangement, it was decided that the configuration required would not al-

low the use of the axial-flow compressor and turbine; and, if an acceptable unit were to be developed, it must be a radial-flow design.

This paper presents the current best design practices and compromises required to arrive at a practical design of the components in a simple-cycle radial-flow gas turbine, and discusses the several factors and variables which affect their performance.

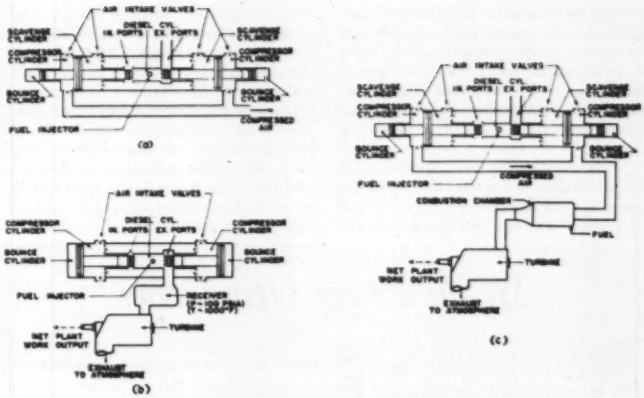
The Free-Piston Engine Development—Present Status and Design Aspects, by A. L. London, Mem. ASME, Stanford University, Stanford, Calif., and A. K. Oppenheim, Mem. ASME, University of California, Berkeley, Calif. 1952 ASME Spring Meeting paper No. 52—S-17 (mimeographed; to be published in Trans. ASME).

A FREE-PISTON machine consists of an opposed-piston two-stroke Diesel driving a reciprocating air compressor. The reciprocating work of the engine piston is supplied directly to the compressor piston, without the intermediary of two crank systems, as employed in the conventional I-C engine reciprocating-compressor combinations. The most notable features of the free-piston system are: (1) Constructional simplicity arising from the absence of cranks and associated bearings; (2) the essentially vibration-free operation provided by the opposed-piston crankless design; and (3) the absence of piston-cylinder side thrust as introduced by crank-connecting-rod systems. These advantages are gained with no sacrifice of thermodynamic performance within the cylinders and, in principle, with a substantial gain in mechanical efficiency as a result of fewer moving parts and lower loadings on the remaining bearing surfaces.

Three applications of free-piston engines are considered in this paper: (1) An internal-combustion-engine air-compressor combination where the useful output is compressed air for pneumatic purposes; (2) an air-compressor combustion-chamber combination for the production of hot gases under pressure for use in a turbine to produce shaft work; (3) the compressor system as described in (1) together with a combustion chamber for internal-combustion heating of the compressed air and then a turbine to utilize the hot gases for the production of shaft work.

Performance data for several existing free-piston systems are presented together with the results of cycle studies. The thermodynamic-dynamic design aspects are considered relative to the conventional crank-type reciprocating internal-combustion-engine system.

The general conclusion reached is that the free-piston system has the prime advantages of excellent thermodynamic performance combined with mechanical simplicity. Consequently, a major development effort appears to be well warranted.



BASIC APPLICATIONS OF THE FREE-PISTON SYSTEM

[(*a*) As an air compressor with no engine-cylinder supercharge; (*b*) as power gas generator with high engine-cylinder supercharge pressure (approximately 7 atm) and a gas turbine; (*c*) as an air compressor, combustion chamber, turbine prime mover.]

Waste-Wood-Fired Gas-Turbine Power Unit, by George H. Atherton and S. E. Corder, Oregon Forest Products Laboratory, Corvallis, Ore. 1952 ASME Spring Meeting paper No. 52—S-18 (mimeographed).

A SMALL laboratory gas turbine has been fired with sawdust at the Oregon Forest Products Laboratory. This work is a part of a program directed toward the generation of power from waste wood. Combustion efficiencies of 92.5 to 99 per cent were obtained with heat-release rates up to 900,000 Btu per sq ft per hr and 190,000 Btu per cu ft per hr. The maximum static-pressure loss through the furnace grate was 0.26 in. of water.

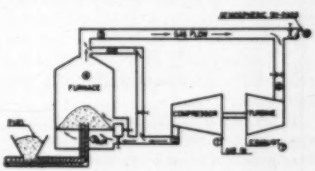
The ultimate objective of this project is to develop firing equipment for a gas-turbine-power unit that will serve as a source of power in sawmills and use wood waste as fuel.

The idea behind this work was presented in an ASME Student Conference Paper Contest in May, 1950. Interest aroused by the paper was largely responsible for the author's decision to attempt development of the idea.

Consultations between members of the Oregon Forest Products Laboratory, the director of the Oregon State College Engineering Experiment Station, and the author in June, 1950, resulted in the Laboratory's decision to attempt development, of a wood-waste-fired gas-turbine-power unit.

An experimental unit was constructed and has been in operation since November, 1950. Test work with this experimental unit is concluded, but combustion-chamber research is being continued.

Prior to actual construction of the experimental turbine unit, rather extensive investigations were conducted to determine the availability and long-range aspect of waste-wood fuel supplies in Oregon. These studies showed that the waste-wood fuel produced in the manufacture of lumber is much greater in volume than that required to supply the power requirements of the sawmill. Further studies revealed that one area in Oregon had, within a 30-mile radius, a long-range fuel potential of 850 units (200 cu ft per unit) of unused waste wood per day. If the sawmills operate 8 hours per day, 5 days per week, this represents a waste of 25,000 hp continuously. Another area, within a 5-mile radius, had a continuous power potential of 15,000 hp, based upon unused waste-wood supplies readily available at the sawmills. The horsepower potential figures are based upon an assumed over-all energy-conversion efficiency of 15 per cent.



SAWDUST-FIRED GAS TURBINE

The experimental sawdust-fired gas turbine is an aircraft turbosupercharger set up as an open-cycle gas turbine, using a waste-wood-fired combustion system consisting of an underfeed stoker supplied with undergrate air, overfire-air jets and dilution air admitted above the furnace.

Oil-fired turbines are usually controlled by regulation of the fuel rate. In the sawdust-fired gas turbine, regulation of fuel supply does not give immediate control, however, as there is always a reserve of fuel in the furnace which continues to burn at a rather fixed rate after the fuel rate is reduced. Turbine temperature (and consequently turbine speed) was, therefore, controlled by varying the undergrate air supply to the furnace to give an immediate change in burning rate. Once this was accomplished the fuel rate was increased or decreased to serve as the primary control of turbine-inlet temperature.

Steam Power Generation

Broom Closets or the Effect of Maintenance Upon Design of Steam Power Plants, by B. C. Mallory, Mem.ASME, and F. W. Argue, Mem. ASME, Stone and Webster Engineering Corporation, Boston Mass. 1952 ASME Spring Meeting paper No. 52—S-12 (mimeographed).

MAINTENANCE costs for the past decade in steam power plants have risen faster in proportion to total production expenses than fuel and operating costs. This paper discusses some of the methods being employed by power-plant designers in an effort to arrest or reverse this trend by providing adequate space for maintenance and including in the plant layout a sufficient number of what might be called "Broom Closets."

Maintenance is defined as the cost of labor, replacement parts, and supervision. Strictly considered, it might include the cost of outage time of the equipment being maintained. Outages quite often require the operation of older and less efficient equipment; hence the length of outage time may not only affect the cost of labor but also the fuel cost of the plant or system.

In general, maintenance may be minimized by: (1) Installing equipment that has demonstrated its reliability, (2) selecting equipment that may be disassembled, repaired if necessary, and assembled again readily, (3) providing facilities to permit rapid overhaul, and (4) keeping equipment in good operating condition by periodic overhauls rather than operating until a breakdown occurs requiring major replacements.

This paper deals with the third requirement: provision in the plant layout for space and facilities which will permit rapid overhaul or replacement and for such broom closets as will improve the accessibility of maintenance tools and equipment.

It has been common practice to provide some space for dismantling main turbine-generators and boiler feed pumps as well as for cleaning and retubing condensers, but with the increased complications of modern steam-power plants there are many other items for which the designer should make provision. Some of these may be needed at regular intervals while others may never be required and are more in the nature of insurance.

Fuels

Technical and Commercial Factors Relating to Trans Mountain Oil Pipe Line, by D. L. Roberts, Canadian Bechtel Limited, Vancouver, British Columbia, Can. 1952 ASME Spring Meeting paper No. 52—S-19 (mimeographed).

OIL discoveries in the Province of Alberta have continued steadily throughout the past 5 years until now it is necessary that new markets be found if the present supply is to be fully utilized and further exploration not be retarded. This report tells the story of a big-inch pipe line which will carry Alberta oil to a new market on the Pacific Coast. The technical problems of location, design, and construction of the pipe line are presented as well as the commercial factors which make the line feasible. The probable effect of Alberta oil on the Pacific Coast oil industry and fuel supply is also discussed.

The line will be approximately 700 miles long and will be constructed of 24-in-diam pipe. Construction is scheduled to be completed by the end of 1953. Initially the pipe line, with two pumping stations, will have a throughput capacity of 75,000 bpd. The addition of four more pumping stations will increase the throughput to 200,000 bpd.

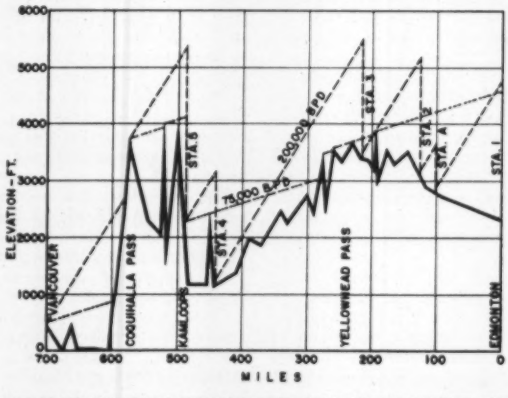
Present California reserves appear inadequate to supply the Pacific Coast demands much longer. Alberta oil, delivered through Trans Mountain pipe line, could supplement the California production.

New refinery capacity is indicated on the Pacific Coast in the next few years. Additional capacity is planned for British Columbia to meet the local demand, but the largest potential development centers in Washington and Oregon.

Aside from the economic aspects of the line, it is important to the defense of the Pacific Northwest.

Burning Sulphite Waste Liquor, by H. A. Sorensen, Mem. ASME, State College of Washington, Pullman, Wash. 1952 ASME Spring Meeting paper No. 52—S-21 (mimeographed).

A SURVEY of the literature indicated that waste sulphite liquor discharged from paper-mill digesters had not been successfully burned in boiler furnaces without auxiliary fuel firing. An experimental refractory-lined furnace of 25 cu ft capacity has been constructed to study the ignition and combustion characteristics of this waste fuel. The sulphite



PROFILE OF TRANS MOUNTAIN PIPE LINE WITH HYDRAULIC GRADIENTS AND PUMPING STATION LOCATIONS FOR THROUGHPUTS OF 75,000 AND 200,000 BPD

liquor, concentrated to 55–60 per cent solids, readily ignites and burns with a relatively long orange-colored flame of medium brightness. The stability of combustion indicates that the sulphite liquor will burn alone, and a redesign of the firing equipment can be expected to result in improved performance.

Early in 1950 it was proposed that the Division of Industrial Research at the State College of Washington undertake a study of the combustion of waste sulphite liquor. General information available at the time indicated that this waste material could not be burned successfully in conventional furnaces. Accordingly, in July, 1950, a project was set up and a graduate research assistant assigned to the initial phase of the work.

The results of this project have demonstrated that it is possible to maintain stable combustion of calcium-base waste sulphite liquor without use of auxiliary fuels. Furnace preheating is necessary in order to establish proper conditions for ready ignition of this waste fuel. These conclusions are applicable only to a refractory-lined furnace. It is possible that combustion of this waste fuel in water-cooled furnaces will be dependent upon the use of a piloting fuel, e.g., oil or coal.

Production Engineering

Project Work for Industrial-Engineering Students, by Byron W. Saunders, Mem. ASME, Cornell University, Ithaca, N. Y. 1951 ASME Annual Meeting paper No. 51—A-141 (mimeographed).

CORNELL is concerned primarily with the training of engineers. In the Industrial option this requires, in addition to the courses in Basic Science, Applied Science, and the Engineering Sciences, work applicable to industrial problems that will give the student the tools necessary to properly identify a problem, to analyze it, and to design his solution. In any curriculum, the courses that are given to accomplish this purpose do not do the job completely. Students, unfortunately, consider each course as a complete entity and not as one unit of an integrated educational program. In order to dispel this concept and to pull together what may appear to the student a rather disjointed curriculum, Cornell has required a project of all fifth-year students. (The Cornell curriculum requires five years for the baccalaureate degree.) It is this project that has become the heart of the curriculum.

The purposes of the project are manyfold. When projects of this type were first considered there were certain definite objectives. First, to assure as complete a correlation and integration of the previous four years' course work as possible. Second, to emphasize the technical, functional, organizational, and personnel relationships of modern industry. Third, to provide a real problem in which the student would be working under his own initiative and using his own creative ability in design. Fourth, to provide some concept of actual engineering work in a manufacturing establishment such as group activity, the making of estimates and providing of information by one group to another, time factors, and similar related problems of organization and operation that are difficult, if not impossible, to reproduce in the normal classroom situation. To accomplish these objectives, a problem from industry was required that first was rather broad in its scope in order to encompass as much subject matter as possible within the problem itself, and second, having found an adequate situation, find the company that would turn over its records "lock, stock, and barrel" so that the students would have available the normal information and environment of an engineer within industry.

The concern which provided the problem was the Goulds Pumps, Inc., Seneca Falls, N. Y.

The product chosen for the problem was a shallow-well pump which has been manufactured by Goulds since 1946, and intended for use in domestic installations on farms and other areas not supplied by municipal water systems. All the statistics of sales, inventory, costs, designs, and production schedules of not only this particular pump but of all other pumps manufactured by Goulds in the same shop and utilizing the same manufacturing equipment were made available. This information was studied and then filed so that the faculty would have complete information about the product, its companion products, and, in general, the situation as it exists in the plant at Goulds. However, very little of this information was ever given to the students.

The problem took the students back to the situation that existed at Goulds in 1946 before this shallow-well pump was put on the market. It was assumed that Goulds had a manufacturing plant with some idle capacity, a line of pumps which could not compete in the low-priced shallow-well domestic market, and a tentative design that would fill this void in their product line. The basic question then became, "Should Goulds proceed further with this design, establish manufacturing procedures and policies, and finally introduce this new design into their product line and attempt to compete with the existing manufacturers in this field?" As any engineer will recognize, this question raises countless other questions that must be answered by someone in the manufacturing organization.

Answers to these questions constituted the work of the students.

ASME Transactions for April, 1952

THE April, 1952, issue of the Transactions of the ASME (available at $1 per copy to ASME members; $1.50 to nonmembers) contains the following:

TECHNICAL PAPERS

A New High-Yield-Strength Alloy Steel for Welded Structures, by L. C. Bibber, J. M. Hodge, R. C. Altman, and W. D. Doty. (51—PET-5)

Fatigue Tests of Piping Components, by A. R. C. Markl. (51—PET-21)

Analysis of Some Corrosion Problems in Petroleum Refineries, by John F. Mason, Jr. (51—PET-4)

The Stresses in a Pressure Vessel With a Conical Head, by G. W. Watts and H. A. Lang. (51—PET-8)

Recommended Practices for the Cleaning of Turbine Lubricating Systems After Service, by Joint ASTM-ASME Committee. (50—A-116)

Line-Reversal Techniques in the Determination of Temperature of Gun Flash or Other Rapid Transient Phenomena, by J. T. Agnew. (51—F-6)

Distribution of Heat-Transfer Coefficients Around Circular Cylinders in Crossflow at Reynolds Numbers From 20 to 500, by E. R. G. Eckert and E. Soehngen. (51—F-9)

Peculiar Behavior of Steel Beams Under Dead Loads That Produce Inelastic Strains, by H. T. Corten, M. E. Clark, and O. M. Sidebottom. (51—F-4)

An Experimental Investigation of Over-Straining in Mild-Steel Thick-Walled Cylinders by Internal Fluid Pressure, by M. C. Steele and John Young. (51—F-3)

Dynamic Properties of Nodular Cast Iron—Part 1, by Harry Majors, Jr. (51—F-5)

Relaxation of Stress in a Heat-Exchanger Tube of Ideal Material, by E. A. Davis. (50—A-122)

Notes on a Theoretical Basis for Design of Tube Sheets of Triangular Layout, by I. Malkin. (50—A-120)

Analysis of Stresses and Displacements in Heat-Exchanger Expansion Joints, by Glenn Murphy. (50—A-133)

Strain-Hardening and Softening With Time in Reference to Creep and Relaxation in Metals, by A. Nadai. (50—A-121)

Automatic Flight Control—Analysis and Synthesis of Lateral-Control Problems, by R. N. Bretoi. (51—IIRD-1)

COMMENTS ON PAPERS

Including Letters From Readers on Miscellaneous Subjects

Methods of Storing Coal

COMMENT BY H. C. CARROLL[1]

This paper on coal storage[2] covers very well the main precautions necessary to prevent spontaneous combustion in coal-storage piles.

There is one point in connection with putting coal into storage we would like to emphasize. It is often found desirable to store coal that has an appreciable sulphur content, often up to 3½ per cent sulphur. It is important in the larger storage piles that the coal be well distributed to avoid segregation and that it be packed very hard. Carryalls drawn by heavy tractors with bulldozer fronts are being used to advantage for coal-storage purposes. The same equipment is used also for storage recovery, when the bulldozer blade is replaced by a series of steel forks which loosen up the coal so that the carryall can pick up its load easily. These carryalls have capacities up to 15 tons or more and can distribute coal in even layers, with the tractor's doing the packing at the same time the coal is distributed.

One large power plant in Indianapolis employs this method, storing Indiana screenings of fairly high sulphur content up to 20 ft in thickness and has had practically no spontaneous combustion over long periods of storage. Water does not penetrate very deeply into the pile, and owing to the packing, little air space is left in the pile.

All the other precautions tabulated in the paper should be applied to this type of storage as well as the other methods described.

COMMENT BY M. K. DREWRY[3]

The account of heating of new coal packed between piles of older coal is of interest and checks with experiences at Lakeside. An explanation would be of interest.

For limited storage areas, and to help avoid surface fires, a road-building procedure can be used to advantage to increase the angle of repose and to pack consistently to within an inch or two of the sides of the pile.

In the past, shoulders on road fills usually were made rounded, causing occasional "falls" to equipment when trying to pack the rounding shoulder. Trial of up-pointed shoulders, with a slope of approximately 15 deg toward the road center, not only has resulted in good packing to the very surface of the slope but has permitted steeper slopes.

Coal-pile slopes of 35 deg usually result when the foregoing packing method is not used. Experience of others indicates that 45-deg slopes are practical with the road-building method of up-pointed shoulders. Tires or "cats" of graders or tractors can run parallel to such slopes, packing to the face of the slope.

Avoidance of coal-pile fires by improved techniques has helped industry substantially.

COMMENT BY W. D. LANGTRY[4]

The author's reference to the packing of piles of coal in order to keep them as solid as possible is one of the prime factors in the successful storing of coal. The writer knows of quite a few instances, especially in the case of coal stored on the dock, where wind was able to circulate through sized coal and thus feed oxygen into the interior of the pile. This oxygen eventually came in contact with some of the fine coal that had accumulated inside the pile during the loading of the coal onto the dock, and thus produced spontaneous combustion. This goes to prove that the infiltration of air through a coal pile introduces the very element which should be eliminated in order to make for successful storage.

The attempted ventilation of a coal pile courts trouble. While ventilation, of course, is in itself a good feature, it is almost impossible to tell when a pile is ventilated or enough air is being admitted in order to produce spontaneous combustion.

Another point that comes up quite frequently is that coal during the summer has been received at its destination so hot that steam is emitted. Many inquiries have been made as to why coal out of the mine possibly only three or four days should arrive at its destination in so hot a condition that it really should not be put into a storage pile. The reason for this is that empty steel railroad cars become so saturated with heat from the sun's rays that when the car is put under the tipple either the heat from the car is transmitted to the coal loaded therein, or the coal is cool enough to reduce the temperature of the steel of the railroad car. There is no way to determine which will prevail. It is a hazardous practice to unload hot coal into a storage pile. This might be the means of accumulating enough heat inside a pile to give the coal its start toward spontaneous combustion.

During World War I, a very complete record was kept of the interval from the time coal was first put in storage until it showed evidence of heating. Invariably, it was found that if coal was going to heat spontaneously, it would take place within about 90 days after it had been placed in the storage pile. In other words, if, after the expiration of a 90-day period, the coal had not heated, it was safe to assume that there would be no trouble from spontaneous combustion. However, other factors subsequently might enter into the contamination of the coal, such as having been placed over embedded steam pipes, hot-water lines, or other heat sources.

In recent years there has been developed a laboratory test that is called the "free swelling index" (FSI). This test indicates the deterioration of coal resulting from oxidation. The test can be applied to advantage by taking a sample of a coal when it is placed in storage and having the FSI index determined. Then, after the coal has been in storage, another sample can be taken in order to find out whether the same index number is obtained. If there is a falling off in the index it might indicate that the coal has oxidized to a certain extent. The FSI test consists of obtaining a coke button which is then compared with standard profiles that are

[1] Consulting Engineer, Carroll, Bechtel & Langtry, Chicago, Ill. Mem. ASME. Deceased Dec. 25, 1951.

[2] "Storage of Coal," by W. L. Lundy, MECHANICAL ENGINEERING, vol. 73, November, 1951, pp. 883–884.

[3] Chief Engineer of Power Plants, Wisconsin Electric Power Company, Milwaukee, Wis.

[4] President, Commercial Testing & Engineering Company, Chicago, Ill. Mem. ASME.

numbered. The index number of the profile most nearly corresponding to the coke button is taken as the free swelling index. In some cases, there is no formation of a button at all which indicates that all coking qualities have been lost. This might be a very important test to make especially if coal is being stored for coking purposes.

AUTHOR'S CLOSURE

The author is grateful for the comments covering the subject paper by Messrs. Carroll, Drewry and Langtry, which, in general, confirm the author's conclusions.

Mr. Drewry suggests it would be of interest to have an explanation as to why new coal packed between piles of older coal usually fires.

One theory for the cause of firing in the new coal can be explained by the fact that moisture from the old coal-pile surface normally vaporizes due to internal heating and is carried away by atmospheric air. This vapor now passes into the new coal body which is comparatively cooler and condenses on the new coal surfaces, thereby permitting the coal to absorb sufficient heat to accelerate the oxidation of certain hydrocarbons to a point where the critical temperature is reached.

W. L. LUNDY.[8]

[8] Kimberly-Clark Corporation, Neenah, Wis. Mem. ASME.

REVIEWS OF BOOKS

And Notes on Books Received in the Engineering Societies Library

Sir Christopher Wren

WREN: HIS WORK AND TIMES. By John Lindsey. The Philosophical Library, New York, N. Y., 1952. Cloth, 5¼ × 8¼ in., illus., appendixes, index, 256 pp., $6.

REVIEWED BY J. K. FINCH[1]

THIS is the story of a great architect who lived and worked in a most interesting period of British history, but it is not the story of a man or of a period which has any very direct engineering interest.

The life of Sir Christopher Wren (1632–1723) spanned almost a century and spread over no less than eight British governments; from that of James I through Charles I, the Commonwealth and Cromwell, through the Restoration of 1660 and Charles II, then James II and the bloodless Revolution of 1688 to the more peaceful waters of the reign of William and Mary, and on through Anne's short reign into that of George I. While his father and uncle, Royalists and loyal servants of the Church of England, felt the pressure of the Roundheads and Puritan severity, Wren escaped all this, and, turning to architecture rather late in life, under the Restoration he became Britain's outstanding church builder. A trip to Paris in 1665, whereby he happily escaped the Plague in London, seems to have exercised a vitally important influence in developing his architectural tastes and interests. But it was the destruction of London in the great fire of the following year that gave Wren his opportunity. St. Paul's is, of course, his greatest work but he built no less than 52 city churches of which 35 were still standing before World War II, although there are only five which escaped damage in the blitz which followed. It was, in fact, the rebuilt London of Wren's churches that lasted through to World War II; a London restored, after the fire of 1666, to the same old street lines, property owners would not listen to ideas for a new street system, and with better brick buildings replacing the old timber and plaster, but a London of low structures dominated by the towers and steeples of Wren's creation.

Mr. Lindsey's book tells briefly the history of most of these churches, as well as Wren's few other, secular works. It describes his works but, unfortunately, brings us no enlarged picture of the man who built them. In short it follows so closely the admonition of the famous epitaph at St. Paul's to its great builder; "Reader, if you seek his Monument, look around you," that the life, character, interests, and personality of the creator of these monuments has become secondary. Perhaps this is a natural weakness of all biographies which deal with creative workers, be they artists, architects, or engineers. Their work overshadows their personalities. One would wish also that Wren's times could have been more adequately treated for this book is limited to those influences which directly affected Wren's work and to an enthusiastic, apparently even a rather narrow and biased, glorification of the Royalist cause and of the "mercurial brilliance" and "outstanding statesmanship" of Wren's patron, Charles II, the Merry Monarch.

There had been a few isolated engineering undertakings in the British Isles before the eighteenth century but, as Samuel Smiles, in his famous "Lives of the Engineers," remarks, "we depended for our engineering, even more than we did for our pictures and our music, upon foreigners." One of the outstanding early works was Sir Hugh Myddelton's "New River" water supply of London completed in 1613, probably the first great gravity supply of modern times. Then, throughout the seventeenth century, the project of draining the Great Level of the Fens about Ely passed through repeated stages of activity and decline, largely under the guidance of Cornelius Vermuyden, a Dutchman, who had been knighted by Charles I in 1629.

There had also been developments in lead, copper, tin, iron, and coal mining under Elizabeth and there was an increasing use of coal for fuel throughout Wren's day; but, due to the difficulties of inland transportation, it was limited to coal transported by sea, "sea-coal." Even the iron trade, however, was retarded in its growth by restrictions placed on the further destruction of Britain's forests to supply charcoal for the "voracious ironworkers." The coal-iron, i.e., coke, process was still to come. One sees, in fact, no indication or promise in the seventeen century of the inventive skill and progressive attitude that was to create the Industrial Revolution.

On the other hand, Charles II did, with the aid of such competent workers as Mr. Pepys, revive shipbuilding and restore the British navy which had fallen on evil days following the glorious reign of Elizabeth. He thus made Britain a sea power and a trading nation, a vital factor

[1] Dean Emeritus and Renwick Professor of Civil Engineering, Columbia University, New York, N. Y.

in her later industrial economy. But there were also emerging in Wren's days political and economic alignments of town and country which were likewise to vitally affect Britain's entire later history.

We are apt to forget that the seeds of the Industrial Revolution fell on quite different ground in Old England and in New England. It was a classless society of no widely divergent and long-established economic differences in which America began her industrial development. The homeland of the Industrial Revolution, on the other hand, had to face the conflict of interests of the titled landholder, of the industrialist and town dweller, and of long-established privilege and rights. While Wren's days were largely those of political adjustment in Britain—the modern form of British government was being laboriously worked out—they were also marked by a building up of many of these interests which were to so strongly color her later industrial evolution. Indeed they were reflected even in the twentieth century in obstructions and restrictions which retarded the growth of the telephone and electric light in Britain and which, even today, are factors in her struggle to regain her economic equilibrium.

Interesting, however, as these aspects of Wren's times may be to the modern engineer, they had little or no influence on Wren's work and we cannot therefore take the author of this book to task for failing to explore them. Wren was, after all, an outstanding church architect rather than an engineer.

Safety Valve

SAFETY VALVE. Poems by Fred H. Colvin. Exposition Press, New York, N. Y., 1952. Cloth, $5^1/_2 \times 8^1/_2$ in., 96 pp., $2.50.

IT MAY come as a surprise to some of the many friends of Fred H. Colvin, editor-emeritus of *American Machinist*, and author of handbooks and other aids to machinists, to learn that the writing of verses has been for him "a sort of safety valve, over the years, for pent-up emotions of various kinds." It is these verses, many of them "written away from home, in different places, trying to express love, or sympathy, or understanding suitable for the occasion," which comprise the small volume under review.

It is not unusual for men who spend most of their time in shops or with machines and material things, to seek relief from the day's work in the enjoyment of literature, music, and art. Indeed, some technical men take up writing, painting, or the playing of a musical instrument as an avocation or as a change from the demands of earning a livelihood, but few go in for what Fred Colvin calls "versifying."

A reading of Mr. Colvin's verse reveals a man of varied interests and alert to the world about him, who has an urge to express feelings for which mere prose seems to be inadequate. He is indeed a fortunate man who can equip himself with such a safety valve.—G. A. S.

Books Received in Library

CHAMBRES D'EQUILIBRE. By M. Alfred Stucky. École Polytechnique de L'Université de Lausanne, Lausanne, Switzerland, 1951. Paper, $6^3/_4 \times 8$ in., 124 pp., diagrams, charts, 15 fr. Part of a course on the regulation of flow in water conduits. The first two chapters cover the reason for surge chambers and the general theory concerning their operation. The influence of turbine regulation on surge-chamber impulses is discussed, and the action of the main types is analyzed in detail, including the restricted-orifice and differential types.

CHAUFFAGE ET SECHAGE PAR LAMPES A RAYONNEMENT INFRA-ROUGE. By M. La Toison. Editions Eyrolles, Paris, France, 1951. Paper, $6^1/_2 \times 9^3/_4$ in., 112 pp., tables, diagrams, 790 fr. Covers heating and drying by means of infrared radiation. General principles of heat transfer and the characteristics of infrared lamps are dealt with prior to the specialized treatment of infrared utilization. Several actual installations are briefly described in the final chapter.

ELEMENTS OF PHYSICAL METALLURGY. By Albert G. Guy. Addison-Wesley Press, Inc., Cambridge, Mass., 1951. Cloth, $7^1/_2 \times 9^3/_4$ in., 293 pp., illus., tables, charts, diagrams, $6.50. A textbook for courses in fundamentals of physical metallurgy, suitable for engineering and science students as well as metallurgy majors. An introductory section is followed by four chapters on the structure of metals and alloys of which the chapter on equilibrium diagrams is the most extensive. Succeeding chapters develop the concept that metallic structure and properties are related, but the emphasis is on properties. The four final chapters deal with diffusion in metals, grain growth, age hardening, and the heat-treatment of steel.

ENERGY SOURCES—THE WEALTH OF THE WORLD. By Eugene Ayres and Charles A. Scarlott. McGraw-Hill Book Co., Inc., New York, N. Y., first edition, 1952. Cloth, $6^1/_4 \times 9^1/_4$ in., 344 pp., illus., charts, tables, $5. This analysis of a highly important problem provides a detailed review of the size of energy sources, technology of production, efficiency of conversion, and the progress being made in conversion. Oil, coal, gas, hydroelectric power, solar and nuclear energy, wind, tidal power, and other minor sources, all are assessed and dealt with according to their relative importance. An "energy balance sheet" for the U. S. is tabulated and discussed in the last chapter.

ENGINEERS' ILLUSTRATED THESAURUS. By Herbert Herkimer. Chemical Publishing Company, Inc., New York, N. Y., 1952. Cloth, $5^3/_4 \times 8^1/_4$ in., 572 pp., diagrams, $6. Over 8000 machine elements from simple handles and clamps to complex mechanisms and special devices are named and illustrated, with brief explanations where necessary. They are grouped in the following broad classifications: fasteners, adjusting devices, supports and structures, basic mechanical movements, hoisting and conveying equipment, transmission of liquids and gases, combustion, prime movers, transportation, industrial processes, electrical appliances, heating, and air conditioning.

FUNDAMENTALS OF ATOMIC PHYSICS. By Saul Dushman. McGraw-Hill Book Company, Inc., New York, N. Y. First edition, 1951. Cloth, $6^1/_4 \times 9^1/_4$ in., 294 pp., diagrams, tables, charts, $5.50. Designed to be as simple as possible in treatment, this book gives engineers and other technical men a practical knowledge of atomic and nuclear fundamentals. Topics covered include the kinetic theory of gases, the charge and mass of the electron, electronics, photoelectric effects, x rays, matter waves, isotropes, and a condensed presentation of nuclear phenomena. The final chapter gives the characteristics of the several types of generators for the acceleration of high-energy particles, the cyclotron, betatron, and so on.

GRAPHIC AIDS IN ENGINEERING COMPUTATION. By Randolph P. Hoelscher, Joseph Norman Arnold, and Stanley H. Pierce. McGraw-Hill Book Co., Inc., New York, N. Y. First edition, 1952. Cloth, $6 \times 9^1/_4$ in., 197 pp., charts, tables, $4.50. Covering a wide range of graphical and mechanical methods, this text includes chapters on the standard slide rules, the derivation of empirical equations from laboratory or field data, the construction of nomographs by geometric methods and with determinants, the construction of special slide rules, graphical differentiation, and movable-scale nomographs. Basic facts are stated, detailed instructions are presented, and the student's understanding of the subject is extended and tested by representative groups of problems.

HANDBOOK OF DANGEROUS MATERIALS. By N. Irving Sax.—Reinhold Publishing Corporation, New York, N. Y. 1951. Cloth, $7 \times 10^1/_4$ m., 848 pp., tables, diagrams, charts, $15. Over 5000 hazardous industrial materials, including trade-name products, are covered in this extensive compilation under four major groups: general chemicals, explosives, fungus diseases and fungicides, radiation and radiation hazards. Detailed information is given on hazardous properties and situations, safety precautions, symptoms, treatment, and antidotes, handling and storage methods, shipping regulations, and so on. The radiation section contains the most recent data available and a general discussion of the problem as well. The alphabetical arrangement of the first and largest section, a general index, and a cross-reference system provide ready access to the information contained in the volume.

MATERIALS TECHNOLOGY FOR ELECTRON TUBES. By Walter H. Kohl. Reinhold Publishing Corporation, New York, N. Y., 1951. Cloth, $6^1/_4 \times 9^1/_4$ in., 493 pp., illus., diagrams, tables, charts, $10. The materials dealt with are the main solids which enter into the construction of electron tubes: glass, ceramics and mica, tungsten, molybdenum, tantalum, nickel, copper, carbon, and graphite. Physical and chemical characteristics are tabulated and discussed, processes for application are considered, and modern techniques of construction are described. Special topics are taken up in later chapters: ceramic-to-

metal seals, the phase rule, high-vacuum technique, and thermionic emission.

MODERN MAGNETISM. By L. F. Bates. Cambridge University Press, New York, N. Y. Third edition, 1951. Cloth, $5^1/_2 \times 8^3/_4$ in., 506 pp., diagrams, charts, tables, 55.50.

As in earlier editions, the author avoids a strictly theoretical treatment by giving descriptions of fundamental experiments. Major contributions to the subject during the past ten years have been worked into the book at the appropriate places.

ASME BOILER CODE

Interpretations

THE Boiler Code Committee meets monthly to consider "Cases" where users have found difficulty in interpreting the Code. These pass through the following procedure: (1) Inquiries are submitted by letter to the Secretary of the Boiler Code Committee, ASME, 29 West 39th Street, New York 18, N. Y.; (2) Copies are distributed to Committee members for study; (3) At the next Committee meeting interpretations are formulated to be submitted to the ASME Board on Codes and Standards, authorized by the Council of the Society to pass upon them; (4) They are submitted to the Board for action; (5) Those which are approved are sent to the inquirers and are published in MECHANICAL ENGINEERING.

(The following Case Interpretations were formulated at the Committee meeting January 25, 1952, and approved by the Board, April 2, 1952.)

CASE No. 1150-1 (Reopened)

(Special Ruling)

Inquiry: Is it permissible to use the following ASTM Emergency Alternate Provisions affecting existing Code specifications

EA-167-44	EA-249-47
EA-213-51T	EA-271-47
EA-240-49	EA-312-51T

Reply: It is the opinion of the Committee that the above listed ASTM Emergency Alternate Provisions in the corresponding Code specifications may be considered as meeting the intent of the Code.

CASE No. 1152

(Special Ruling)

Inquiry: May the revised Section IX, Welding Qualifications, published in the February, 1952 issue of MECHANICAL ENGINEERING, be used in construction under the Code?

Reply: It is the opinion of the Committee that revised Section IX, Welding Qualifications, which has been approved, can be used in Code construction.

Cases Annulled

Case Nos.	*Reason for Annulment*
780	Contrary to present concept.
793	Covered by Case No. 1074.
942	Wrought iron as Code material no longer used, except possibly for staybolts.
987	Properties of carbon molybdenum grade of material covered are similar to those of Grade F-1 of SA-182.
1030	Written to answer specific inquiry since withdrawn.
1041	Material very close to Grade WC5 of SA-217; stress allowances same for both grades.
1060	See italicized note under specification heading SA-83, Section II.
1071	Applies to acceptance of variance in chemical composition under SA-213(T-13). Now covered by Case No. 1116.
1087	All revisions contained now in Section I 1949.
1121	Revisions of tube tables and formulas now in 1951 Addenda.
1129	Revisions now in Table P-5 1951 Addenda.
1132	Provisions now in 1951 Addenda.
1143	Provisions now in 1951 Addenda.
1145	Revised stress tables now in 1951 Addenda.

Proposed Revisions and Addenda to Boiler Construction Code

AS NEED arises, the Boiler Code Committee entertains suggestions for revising its Codes. Revisions approved by the Committee are published here as proposed addenda to the Code to invite criticism. If and as finally approved by the ASME Board on Codes and Standards, and formally adopted by the Council, they are printed in the annual addenda supplements to the Code. Triennially the addenda are incorporated into a new edition of the Code.

In the following the paragraph numbers indicate where the proposed revisions would apply in the various sections of the Code. Simple changes are indicated directly. In the more involved revisions added words are printed in SMALL CAPITALS; deleted words are enclosed in brackets [].

Comments should be addressed to the Secretary of the Boiler Code Committee, ASME, 29 West 39th Street, New York 18, N. Y.

Power Boilers 1949

PREAMBLE. Revise fifth paragraph, first sentence to read:

Unfired steam boilers shall be constructed under the provisions of Section I, Section V, or Section VIII.

PAR. P-112(c). Delete fourth paragraph. (Note: Welding Operator Qualifications are covered by Par. P-112(e).)

PAR. P-113. Delete second sentence and substitute:

The welds shall be strength welds similar to Fig. P-36 and shall be stress-relieved.

PARS. A-65 TO A-70 AND FIG. A-11. The examples there given have been revised to take advantage of the new stresses in Tables P-5 and P-7. Corrections will be made in the 1952 edition of Section I.

Unfired Pressure Vessels, 1949

PAR. U-2(d). Revise second paragraph, first sentence to read:

Unfired steam boilers shall be constructed under the provisions of Section I, Section V, or Section VIII.

Unfired Pressure Vessels, 1950

PAR. U-2(f). Revise second paragraph, first sentence to read:

Unfired steam boilers shall be constructed under the provisions of Section I, Section V, or Section VIII.

PAR. UG-131. Add as a new paragraph:

(h) It shall be permissible to rate safety valves under the power boiler code, par. P-273(e), with capacity ratings at 3 per cent accumulation, for use on unfired pressure vessels, without further tests. In such instance, the capacity rating of the valve may be increased to allow for the accumulation pressure permitted by par. UG-131 (c), namely, 10 per cent, by the multiplier

$$\frac{1.10\,p + 14.7}{1.03\,p + 14.7}$$

where p = set pressure, psig. Such valve shall be marked in accordance with par. UG-129.

NOTE: This multiplier shall not be used as a divisor to transform test ratings from a higher to a lower accumulation.

Announcement

Form U-1, Manufacturers' Data Report Form for Unfired Pressure Vessels has been revised and is now available.

ASME NEWS

With Notes on the Engineering Profession

1952 ASME Semi-Annual Meeting to Discuss Engineering in a Troubled World

Preliminary Plans Announced for Sessions at Sheraton-Gibson Hotel, Cincinnati, Ohio, June 15–19, 1952

As industry steps up to make a strong America and the nation's interest in engineers is heightened, it is natural that the 1952 Semi-Annual Meeting program of The American Society of Mechanical Engineers, to be held in Cincinnati, Ohio, June 15–19, 1952, with headquarters at the Sheraton-Gibson Hotel, should include discussions of recent engineering developments, the engineering manpower shortage, and the technical and managerial problems encountered in an accelerated and intensified production program.

The technical program to be presented in 42 sessions, luncheon meetings, and the like, also includes panel discussion.

Major administrative functions of the Society are exercized during the Semi-Annual Meeting. Concurrently with the technical program, Society officials will be meeting to plan for future programs. The National Nominating Committee will announce during the course of the meeting, nominees for president, four vice-presidents, and two directors at large.

Also scheduled is the National Delegates Conference, composed of two representatives from each ASME Region, who will consider current questions relating to Society administration suggested by local Sections. The Council of the Society, top-level administrative body, will also meet. One of its most important items of business will be to consider the budget for 1952–1953.

Roy V. Wright Lecture

The Hon. W. C. Foster, Deputy Secretary of Defense, Washington, D. C., has been invited to deliver the Roy V. Wright Lecture. The subject of his talk will be "Technology in a Troubled World." This lecture was established in 1949 to honor Mr. Wright, president of the Society in 1931, for his work in urging good citizenship on the part of engineers. Mr. Foster will be introduced at this lecture by President Pigott of the ASME.

Inspection Trips

Among the plants to be visited, according to list yet to be completed, is included the Barrier Dam. The capacity of each of its pumps is 670,000 gallons per minute against a 29-foot head. The Walter C. Beckjord Station of the Cincinnati Gas and Electric Company, which went into operation April, 1952, has several unique features, among which are that it has no direct railroad connection, it is dependent upon highway and river transportation, and heavy equipment will be handled by cranes. There will be trips to the Cincinnati Milling Machine Company and to the General Electric Jet Center at Lockland, Ohio.

Women's Program

For the entertainment of women attending the Cincinnati Meeting a special program has been prepared which on Monday will feature trips to the Rookwood Pottery, justly famous for its artistic ware; the Taft Museum, the former residence of Mr. and Mrs. C. P. Taft, which was opened as a public museum in December, 1932, under the management of the Cincinnati Institute of Fine Arts, also listed for the enjoyment of the visitors are visits to the Conservatory, luncheons, fashion show, and individual tours to points of interest for which Cincinnati is famous. A trip to Coney Island is planned. New Yorkers may be rubbing their eyes at this one . . . but this is Cincinnati's Coney Island, and a lovely one it is too. Dinner is being arranged at the Moonlight Garden in Coney Island—if the weather permits, the dinner will be served in the patio under the trees. No Cincinnati tour for "engineering" women would be complete without a visit to the Herman Schneider Foundation. All major technical societies in Cincinnati use this building for their headquarters. Mr. Schneider, who originated the co-operative plan of education, was dean of engineering and president of the University of Cincinnati.

The tentative technical program follows:

MONDAY, JUNE 16

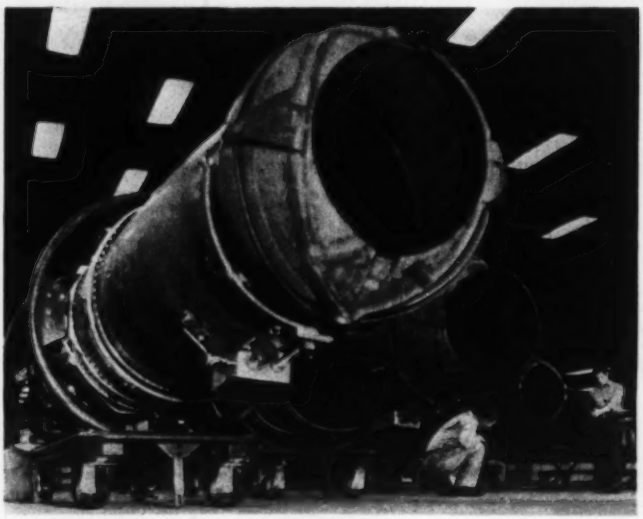
8:30 a.m.

Registration

9:30 a.m.

Hydraulic (I)—Gas Turbine Power (I)

Design Considerations and Development of a Broad-Range High-Efficiency Centrifugal Compressor for a Small Gas-Turbine Compressor, by *I. E. Speer*, assistant projection engineer, gas-



J-47-GE-17 JET ENGINES BEING PREPARED FOR FINAL TESTING AT THE GENERAL ELECTRIC COMPANY'S LOCKLAND, OHIO, JET CENTER, ONE OF THE PLANTS TO BE INSPECTED DURING THE 1952 ASME SEMI-ANNUAL MEETING, SHERATON-GIBSON HOTEL, CINCINNATI, OHIO, JUNE 15–19

turbine project, AiResearch Manufacturing Co., Los Angeles, Calif.

Some Investigations With Wet Compression in Centrifugal Compressors, by *J. T. Hamrick*, NACA Laboratory, Cleveland, Ohio, and *W. L. Beede*, aeronautical research scientist, Compressor and Turbine Divisions, NACA Lewis Flight Propulsion Laboratory, Cleveland, Ohio

9:30 a.m.

Fuels (I)

The Problem (Smoke Inspector's Viewpoint), by *C. W. Gruber*, smoke-abatement engineer, City of Cincinnati, Cincinnati, Ohio

The Solution to the Problem, by *H. C. Ballman*, smoke-regulation engineer, City of Columbus, Columbus, Ohio

The Problem and Solution for Plants With Capacity 100-1200 Lb Per Hr (From the Equipment Manufacturers Viewpoint), by *E. C. Webb*, vice-president, Iron Fireman Manufacturing Corp., Cleveland, Ohio

Applying Fuel-Burning Equipment to Prevent Air Pollution, by *C. E. Miller*, manager, stoker department, Combustion Engineering–Superheater Inc., New York, N. Y.

9:30 a.m.

Petroleum (I)

The Distribution of Mechanical and Thermal Stresses in Multilayer Cylinders, by *R. A. Straub*, research associate, E. I. du Pont de Nemours & Co., Inc., Belle Works, Charleston, W. Va.

The Stresses in a Pressure Vessel With Hemispherical Heads, by *G. W. Watts*, director of engineering, and *H. A. Lang*, project engineer, Standard Oil Co. of Indiana, Chicago, Ill.

9:30 a.m.

Education

Panel Session

Moderator: H. N. Muller, Jr., assistant to vice-president, Westinghouse Electric Corp., East Pittsburgh, Pa.

Subject: Engineering Manpower Problems

9:30 a.m.

Machine Design (I)

High-Speed Surface-Broaching Machine, by *E. J. Risorio* and *E. Rashrs*, The Cincinnati Milling Machine Co., Cincinnati, Ohio

Machine-Tool Lubrication, by *J. R. Keen*, sales manager, King Machine Tool Division, American Steel Foundries Corp., Cincinnati, Ohio

12:15 p.m.

President's Luncheon

Speaker: The President, *R. J. S. Pigott*, Fellow ASME

Presiding: G. H. Larkin, district manager, Hagan Corp., Cincinnati, Ohio

Address of Welcome: Hon. C. W. Rich, The Mayor of the City of Cincinnati

2:30 p.m.

Gas Turbine Power (II)—Hydraulic (II)

Performance of a Cascade Designed for Prescribed Loading, by *D. C. Prince, Jr.*, technical engineer, aircraft gas-turbine department, General Electric Co., Lynn, Mass.

An Interferometric Investigation of the Flow Through a Cascade of Turbine-Nozzle Blades, by *C. R. Faulders*, research assistant, Massachusetts Institute of Technology, Cambridge, Mass.

2:30 p.m.

Fuels (II)

Report on Field Tests of Oil and Gas Residential Space Heating, by *A. L. Carroll*, manager, Technical Services Division, Consolidated Edison Co. of New York, Inc., Mt. Vernon, N. Y.

Properties of Coal, Their Influence on Performance of Coal-Burning Apparatus, by *B. E. Tate*, chief engineer, power plant, National Cash Register Co., Dayton, Ohio

2:30 p.m.

Metals Engineering (I)

Axial Tension and Bending Interaction Curves for Members Loaded Inelastically, by *D. O. Brush*, stress analyst, North American Aviation's Aerophysics Laboratory, Downey, Los Angeles, Calif., and *O. M. Sidebottom*, college of engineering, University of Illinois, Urbana, Ill.

The Influence of Aging on the Bauschinger Effect in Inelastically Strained Beams, by *T. M. Elsesser*, instructor, *O. M. Sidebottom*, assistant professor, and *H. T. Corten*, assistant professor of theoretical and applied mechanics, University of Illinois, Urbana, Ill.

The Effect of Slightly Elevated Temperature Treatment Upon Microscopic and Submicroscopic Residual Stresses Induced by Small Inelastic Strains in Metals, by *H. T. Corten*, assistant professor of theoretical and applied mechanics, and *T. M. Elsesser*, instructor, University of Illinois, Urbana, Ill.

2:30 p.m.

Petroleum (II)

Continuous Viscosimetry, by *R. W. Fritzsche*, Fischer & Porter Co., Dallas, Texas

Infra-Red CO Gas Analyzers—A Tool for After-Burning Prevention, by *J. L. Serrill*, Leeds & Northrup, Philadelphia, Pa.

Centralized Instrumentation, by *R. A. Schlegel*, Brown Instrument Division, Minneapolis-Honeywell Regulator Co., Philadelphia, Pa.

2:30 p.m.

Machine Design (II)

Pressure Angles in Cam Roller Followers, by *G. Y. Ono*, instructor, machine design, Case Institute of Technology, Cleveland, Ohio

Nomograms as Tools to Facilitate the Solution of Engineering Formulas, by *E. C. Varnum*, head, operations research, Barber-Colman Co., Rockford, Ill.

5:00 a.m.

Business Meeting

Presiding: The President *R. J. S. Pigott*

5:30 p.m.

Roy V. Wright Lecture

Presiding: The President, *R. J. S. Pigott*

Lecturer: *W. C. Foster*, Deputy Secretary of Defense, Pentagon Building, Washington, D. C.

Subject: Technology in a Troubled World

8:00 p.m.

Process Industries—Fuels (III)

Flame Velocities in Carbon Monoxide-Oxygen Mixtures, by *T. W. Price*, research associate, Engineering Experiment Station, and *J. H. Potter*, professor of mechanical engineering, University of Illinois, Urbana, Ill.

The Hydrodynamic Resistance of Particles, by *Nicholas Shoumatoff*, process engineer, West Virginia Pulp & Paper Co., New York, N. Y.

8:00 p.m.

Junior

What Does Industry Have to Offer the Young Engineer? by *Ralph Scorah*, head, department of mechanical engineering, University of Missouri, Columbia, Mo., *J. L. Knight*, manager of engineering, Major Electric Co., Louisville, Ky., and *C. T. Wasmer*, president, Rex Engineering Corp., Cincinnati, Ohio

Junior Representatives, Guests of the Old Guard

Akron Section	Dayton Section
T. J. Thaden	John Clary
Canton-Alliance-Massillon Section	Louisville Section
R. L. Holloway, Jr.	David Bond
Central Indiana Section	Oak Ridge Section
D. B. Blue	L. O. Sieg
Cincinnati Section	Toledo Section
J. N. Colebrook	A. L. Clark
Columbus Section	West Virginia Section
M. L. Smith	Reid Earnhardt

8:00 p.m.

Effect of Temperature

Operating Experiences on a Welded Joint Between Austenitic-Ferritic Steels in a Test Bottle Paralleling the Main Steam Line at Philip Sporn Plant, by *G. E. Lien*, staff engineer, Mechanical-Engineering Division, American Gas and Electric Service Corp., New York, N. Y.

Operating Experiences on the Mechanical Joint Connecting Austenitic-Ferritic Materials in the Main Steam Line at Ridgeland Station, by *E. C. Bailey*, supervising mechanical field engineer, Commonwealth Edison Co., Chicago, Ill., *H. C. Schroeder*, engineer, Sargent and Lundy, Chicago, Ill., and *I. Carlson*, Crane Co., Chicago, Ill.

Comparison at Elevated Temperatures of Some Commercial Grades of Ferritic Cast Steels, by *H. H. Wyatt*, *J. W. Bolton*, and *M. L. Steinbuch*, metallurgists, The Lunkenheimer Co., Cincinnati, Ohio

TUESDAY, JUNE 17

9:30 a.m.

Power (I)

Material-Handling Facilities of Walter C. Beckjord Station, by *R. F. Schierland*, Cincinnati Gas & Electric Co., Cincinnati, Ohio

New Steam-Plant Designs on Inland Rivers, by *G. V. Williamson*, Union Electric Co. of Missouri, St. Louis, Mo.

Design for Extreme Flood Conditions at the Paddy's Run Station, by *D. C. Hormell*, chief engineer, Pioneer Service and Engineering Co., Chicago, Ill.

Special Features of Milesburg Power Station, by *R. A. Mycoff*, West Penn Power Company, Milesburg, Pa., and *W. F. Drake*, West Penn Power Co., Pittsburgh, Pa.

9:30 a.m.

Fuels (IV)—Gas Turbine Power (III)

A Study of Burner Oscillations of the Organ-Pipe Type, by *A. A. Putnam* and *W. R. Dennis*, fuels and combustion research division, Battelle Memorial Institute, Columbus, Ohio

A Study of Detonative Phenomena in Gaseous Mixtures by the Use of Shock-Tube Techniques, by *R. B. Morrison*, chief, aircraft propulsion laboratory department, aeronautical engineering, University of Michigan, Ann Arbor, Mich.

9:30 a.m.

Metals Engineering (II)

The Shell Molding Process, by *B. N. Ames*, Senior Metallurgist, Code 982, New York Naval Shipyard, Brooklyn, N. Y.

Metals and Metal Processing in the Atomic-Energy Field, by *A. U. Seybolt*, research metallurgist, Knolls Atomic Power Laboratory, General Electric Co., Schenectady, N. Y.

9:30 a.m.

Machine Design (III)

The Effects of Solid Inclusions in the Oil Supply to Sleeve Bearings, by *H. G. Rylander, Jr.*, assistant professor, mechanical-engineering de-

ASME National Nominations

THE 1952 Nominating Committee is to meet for two days, June 16-17, 1952, at the Hotel Sheraton-Gibson in Cincinnati, Ohio, where the Semi-Annual Meeting will be held. Open hearings will be held for members to speak in behalf of their candidates for the office of President, Regional Vice-President, and Director at Large any time between the hours of 10:30 a.m. to 12 noon; and 2 p.m. to 5 p.m. on Monday, June 16, and on Tuesday, June 17, from 9:30 a.m. to 12 noon. Following the close of business of the 1952 Nominating Committee there will be held an Organization Meeting of the 1953 Committee presided over by the chairman, J. A. Keene, of the 1952 Committee. This meeting will take place on Tuesday evening, June 17, following the Business Meeting of the 1952 Nominating Committee or, if necessary to extend the Business Meeting through Tuesday evening, the Organization Meeting will be held Wednesday, June 18.

Official Notice
ASME Business Meeting

THE Semi-Annual Business Meeting of the Members of The American Society of Mechanical Engineers will be held on Monday, June 16, 1952, at 5:00 p.m., Hotel Sheraton-Gibson, Cincinnati, Ohio, as part of the Semi-Annual Meeting of the Society.

partment, The University of Texas, Austin, Texas

The Use of the Centrifugal Governor Mechanism as a Torsional Vibration Absorber, by *O. A. Pringle*, assistant professor, college of engineering, University of Missouri, Columbia, Mo.

9:30 a.m.

Production Engineering (I)—Metal Cutting (I)—Cutting Fluids (I)

Heat Balance in Metal Cutting, by *K. J. Trigger*, professor, mechanical engineering, University of Illinois, Urbana, Ill., and *B. T. Chao*, assistant professor, mechanical engineering, University of Illinois, Urbana, Ill.

Radioactive Cutting Tools for Rapid Tool-Life Testing, by *M. E. Merchant*, assistant director of research, *Hans Ernst*, director of research, and *E. J. Krabacher*, research engineer, The Cincinnati Milling Machine Company, Cincinnati, Ohio

12:15 p.m.

ESC—ASME Joint Luncheon

Presiding: *F. W. Willey*, president, Willey-Wray Electric Co., Cincinnati, Ohio

Speaker: *W. W. Tangeman*, vice-president, The Cincinnati Milling Machine Co., Cincinnati, Ohio

Subject: How Cincinnati Engineers Co-Operate

2:15 p.m.

Plant Trips

The Walter C. Beckord Station of the Cincinnati Gas and Electric Co., The Cincinnati Milling Machine Co., The General Electric Jet Center, and the RCA Tube Plant

2:30 p.m.

Railroad (I)

A Method of Establishing and Comparing Tonnage Ratings of Diesel Locomotives, by *E. H. Weston*, mechanical engineer, Chicago and North Western Railway Co., Chicago, Ill.

6:00 p.m.

Buses leave hotel for Coney Island. Dinner and cocktails 6:30 p.m. Dancing and amusements later

WEDNESDAY, JUNE 18

8:30 a.m.

Registration

9:30 a.m.

Heat Transfer (I)

Local Heat-Transfer Coefficients on the Surface of an Elliptical Cylinder in a High-Speed Air Stream, by *R. A. Seban*, professor, and *R. M. Drake, Jr.*, assistant professor, mechanical engineering, University of California, Berkeley, Calif.

Additional Measurements of the Heat Conductivity of Nitrogen, Carbon Dioxide, and Mixtures, by *F. G. Keyes*, professor emeritus, lecturer, Massachusetts Institute of Technology, Cambridge, Mass.

Joule-Thomson Coefficients for Air at One Atmosphere, by *J. H. Potter*, professor, mechanical engineering, and *L. N. Tao*, graduate student, department of mechanical engineering, University of Illinois, Urbana, Ill.

9:30 a.m.

Power (II)

Selecting and Training Personnel for Centralized-Control Power Station, by *F. E. Nicosia*, Public Service Co. of Indiana, Inc., Indianapolis, Ind.

Training an Operating Group for a Second Generating Station, by *J. D. Williamson*, assistant manager, Power Production Division, The Dayton Power & Light Co., Dayton, Ohio

Training Power-Plant Employees on the American Gas & Electric System, by *A. H. Beiler*, senior engineer, Mechanical-Engineering Division, and *J. E. Gene*, plant consultant, Mechanical-Engineering Division, American Gas & Electric Service Co., New York, N. Y.

Training of Operating Personnel for Power Plants With Centralized Control, by *D. F. Steinke*, director, power educational department, The Dow Chemical Company, Midland, Mich.

Personnel Training for Ridgeland Station, by *V. L. Stone*, Commonwealth Edison Co., Chicago, Ill.

9:30 a.m.

Gas Turbine Power (IV)—Fuels (V)

Design Factors in the Development of a Small High-Heat-Release Combustor, by *C. S. Stone*, development engineer, AiResearch Manufacturing Co., Los Angeles, Calif.

An Energy Basis for Comparison of Performance of Combustion Chambers, by *J. B. Nichols*, section engineer, General Electric Co., Schenectady, N. Y.

Comparative Performance of Coals of Different Rank in a Film-Cooled Gas-Turbine Combustor, by *T. F. Warren, H. P. Hudson, J. D. Robertson*, research engineer, and *J. C. Mulligan*, Canadian Bureau of Mines, Ottawa, Can.

9:30 a.m.

Railroad (II)

Effect of Impact on Freight Operation Loss and Damage, by *W. A. Murphy*, freight-claim agent, The New York, Chicago and St. Louis Railroad Company, Cleveland, Ohio

Developments in Metallic Friction Draft Gear, by *N. T. Olsen*, vice-president, Peerless Equipment Co., Chicago, Ill.

Developments in Rubber Draft Gears, by Waugh Equipment Co., Chicago, Ill.

9:30 a.m.

Production Engineering (II)—Metal Cutting (II)—Cutting Fluids (II)

The Relative Abrasiveness of the Cast Surfaces of Various Gray-Iron Castings on a Single-Point Tool of High-Speed Steel, by *Joseph Datsko*, instructor, and *O. W. Boston*, professor of mechanical engineering, University of Michigan, Ann Arbor, Mich.

The Influence of Higher Rake Angles on Performance in Milling, by *M. E. Merchant*, assistant director of research, and *J. H. Crawford*, research engineer, The Cincinnati Milling Machine Company, Cincinnati, Ohio

Report of an Investigation of the Strain-Hardening Effect Upon Subsequent Levels Due to Metal Cutting, by *C. L. Sonnenschein*, visiting lecturer, and *W. P. Wallace*, lecturer, department of engineering, University of California, Los Angeles, Calif.

9:30 a.m.

IIRD (I)

Process-Control Terminology, by *M. A. Princi*, General Electric Co., West Lynn, Mass.

12:15 p.m.

Calvin W. Rice Luncheon and Lecture

Presiding: The President, *R. J. S. Pigott*, Fellow ASME

Introduction: *Walker Cisler*, president, Detroit Edison Co., Detroit, Mich.

Speaker: *Piero Ferrerio*, chairman and president, Edison Co., Milan, Italy

Subject: **Past, Present, and Future of the Italian Power Industry**

2:30 p.m.

Heat Transfer (II)—Power (III)

Performance of Finned Tubes in Shell-and-Tube Heat Exchangers, by *D. L. Katz*, professor, and *R. B. Williams*, chairman, chemical and metallurgical engineering department, University of Michigan, Ann Arbor, Mich.

Local Coefficients of Mass Transfer by Evaporation of Water into an Air Jet, by *Maurice Spielman*, associate research engineer, and *Max Jakob*, professor, department of mechanical engineering, Illinois Institute of Technology, Chicago, Ill.

Cooling-Tower Characteristics as Determined by the Unit-Volume Coefficient, by *D. R. Baker*, mechanical engineer, engineering research department, The Marley Co., Inc., Kansas City, Kan.

2:30 p.m.

Gas Turbine Power (V)

A Nondimensional Correlation of Pressure and Scale Effects Upon Flame Speed at Subatmospheric Pressures, by *K. E. Cullen*, research associate, department of aeronautical engineering, aircraft propulsion laboratory, University of Michigan, Ann Arbor, Mich.

A Sonic-Flow Orifice Temperature Probe for High-Gas-Temperature Measurement, by *P. L. Blackshear*, combustion research scientist, Lewis Flight Propulsion Laboratory, NACA, Cleveland, Ohio

2:30 p.m.

Railroad (III)

Developments in Cushioned Underframes, by *W. K. Darbon*, vice-president, The Hulson Co., Chicago, Ill.

Dynamic Testing of Freight Cars, by *J. M. Rockm*, associate director of development, Pullman-Standard Co., Hammond, Ind.

2:30 p.m.

Production Engineering (III)—Management (I)

Economics and Philosophy of Choosing New Machinery and Equipment, by *D. M. Pattison*, vice-president of sales, Warner and Swasey Company, Cleveland, Ohio

An Analysis of Developments in Automation, by *C. J. Jacoby, 3rd*, Graduate School of Business Administration, Harvard University, Boston, Mass.

2:30 p.m.

IIRD (II)

The Process Factors Which Affect Automatic Control, by *J. B. McMahon*, engineer of special applications, Republic Flow Meters Co., Chicago, Ill., and *R. A. Ackley*, chief instrumentation, Consolidated Vultee Aircraft Corp., San Diego, Calif.

A Systematic Design Approach Using Block-Diagram Analysis, by *J. M. Embree* and *S. P. Higgins, Jr.*, research and development engineers, Minneapolis-Honeywell Regulator Co., Philadelphia, Pa.

6:30 p.m.

Reception and Cocktail Party

Cincinnati Industries, host

7:00 p.m.

Banquet

Toastmaster: *D. S. Brown*, vice-president, Cincinnati Gas and Electric Co.

Speaker: *J. E. Tobey*, president, Appalachian Coals, Inc., Cincinnati, Ohio

Subject: Romance of Power and Fuels

THURSDAY, JUNE 19

9:30 a.m.

Management (II)

Personnel Relations, by *H. K. Ewig*, personnel director, The Cincinnati Milling Machine Co., Cincinnati, Ohio

What Engineers Can Do for Better Recognition, by *G. F. Nordenholt*, editor, *Product Engineering*, McGraw-Hill Publishing Co., Inc., New York, N. Y.

9:30 a.m.

Aviation (I)—IIRD (III)—Gas Turbine Power (VI)

A Clearancemeter for Determining Blade-Tip Clearances of Axial-Flow Compressors, by *A. W. Brunot* and *R. O. Fulton*, technical engineers, Thomson Laboratory, General Electric Co., West Lynn, Mass.

Instrumentation for Axial-Compressor Flow Research, by *C. A. Meyer*, Aviation Gas-Turbine

Division, Westinghouse Electric Corporation, Lester, South Philadelphia, Pa., and *R. P. Benedict*.

9:30 a.m.

Materials Handling (I)

Package Handling, by *C. A. Burton*, conveyer sales manager, Lampson Corp., Syracuse, N. Y.

Conveyers in Bulk Handling, by *S. M. Mercier*, chief engineer, Conveyer Division, Jeffrey Manufacturing Co., Columbus, Ohio

9:30 a.m.

Production Engineering (IV)—Cutting Fluids (III)—American Society for Testing Materials

Cutting-Fluid Application, by *R. J. S. Pigott*, director, engineering division, Gulf Research and Development Co., Pittsburgh, Pa.

The Shear-Angle Relationship in Metal Cutting, by *M. C. Shaw*, professor, Massachusetts Institute of Technology, Cambridge, Mass., *N. H. Cook*, instructor, mechanical engineering, Massachusetts Institute of Technology, and *Iain Finnie*, graduate fellow, department of mechanical engineering, M.I.T.

12:15 p.m.

Management—Production Engineering Luncheon

Presiding: *T. A. Marshall, Jr.*, executive secretary, EMC, EJC

Introduction: *E. J. Martin*, chief engineer, Procter & Gamble Co., Ivorydale, Cincinnati, Ohio

Speaker: *J. G. Pleasants*, vice-president and director, manufacturing, Procter & Gamble, Cincinnati, Ohio

Subject: Engineering in Management

2:30 p.m.

Management (III)

Management Training for Development of Leadership, by *H. B. Maynard*, president, Methods Engineering Council, Pittsburgh, Pa.

Stretching Engineering Manpower Through Predetermined Time Standards, by *S. A. Birn*, president, Serge A. Birn Co., Louisville, Ky.

2:30 p.m.

Aviation (II)—IIRD (IV)—Gas Turbine Power (VII)

Fast Thermocouples as Control-System Elements Sensing Exhaust-Gas Temperature in Aircraft Gas Turbines, by *J. S. Alford*, engineer, design review staff, Aircraft Gas Turbine Division, General Electric Co., Lockland, Ohio, and *C. R. Heising*, General Electric Co., Lynn, Mass.

Instrumentation for Recording Transient Performance of Gas-Turbine Engines and Their Control Systems, by *G. J. Delio*, NACA, Lewis Flight Propulsion Laboratory, Cleveland, Ohio, and *G. V. Schwent*

2:30 p.m.

Materials Handling (II)

Materials Handling in and out of Warehouses, by *R. W. Choate*, engineer in charge of manufacturing process, Plant No. 2, Frigidaire Division, General Motors Corp., Moraine City, Ohio

Materials Handling at the New G-E Concentration of Appliance Manufacture in the Louisville Area, by *W. L. Goodfleisch*, manufacturing engineer, appliance parts plant, General Electric Co., Louisville, Ky.

2:30 p.m.

Production Engineering (V)—American Society of Lubricating Engineers

Plant Lubrication Engineering, by *C. L. Pope*, lubrication consultant, Eastman Kodak Co., Rochester, N. Y.

Modern Machine-Tool Lubrication Practices, by *W. D. Whalen*, plant engineer, R. K. Le Blond Machine Tool Co., Cincinnati, Ohio

Definitions, Functions, Types, and Designations of Cutting Fluids, by *O. W. Boston*, professor of mechanical engineering and production engineering, chairman, department of production engineering, University of Michigan, Ann Arbor, Mich.

NATION'S SCHOOLS RECEIVE ENGINEERING POSTER

(To alert high-school students to the opportunities offered by a career in the engineering profession and thus ease the critical shortage of engineers, more than 25,000 posters were mailed on March 24, 1952, to all of the secondary schools throughout the country by the Engineering Manpower Commission of Engineers Joint Council. A. G. Clauson, Jr., president of the New York City Board of Education, received the first of these posters from T. A. Marshall, Jr., executive secretary of the commission, at a ceremony. *Left to right:* Mr. Marshall, Mr. Clauson, and B. G. A. Skrotzski, chairman, Guidance Committee, ECPD.)

ASME Calendar of Coming Events

June 15–19
ASME Semi-Annual Meeting. Sheraton-Gibson Hotel, Cincinnati, Ohio
(Final date for submitting papers was Feb. 1, 1952)

June 19–21
ASME Applied Mechanics Division Conference, The Pennsylvania State College, State College, Pa.
(Final date for submitting papers was Feb. 1, 1952)

June 23–27
ASME Oil and Gas Power Division Conference, Hotel Statler, Buffalo, N. Y.
(Final date for submitting papers was Feb. 1, 1952)

June 26–28
ASME Applied Mechanics Division, West Coast Conference, University of California, Los Angeles, Calif.
(Final date for submitting papers was Feb. 1, 1952)

Sept. 8–11
ASME Fall Meeting, Sheraton Hotel, Chicago, Ill.
(Final date for submitting papers was May 1, 1952)

Sept. 8–12
ASME Industrial Instruments and Regulators Division and Instrument Society of America Exhibit and Joint Conference, Cleveland Auditorium, Cleveland, Ohio
(Final date for submitting papers was May 1, 1952)

Sept. 22–24
ASME Petroleum Mechanical-Engineering Conference, Hotel President, Kansas City, Mo.
(Final date for submitting papers was May 1, 1952)

Oct. 30–31
ASME Fuels and AIME Coal Divisions Joint Conference. Bellevue-Stratford Hotel, Philadelphia, Pa.
(Final date for submitting papers—June 1, 1952)

Nov. 30–Dec. 5
ASME Annual Meeting, Statler Hotel, New York, N. Y.
(Final date for submitting papers—July 1, 1952)
(For Meetings of Other Societies see page 421)

ASME Lubrication Activity Meeting Announced

THE second meeting of the Lubrication Activity group will be held June 16, 1952, at 9:30 a.m., during the ASME Semi-Annual Meeting to be held at the Sheraton-Gibson Hotel, Cincinnati, Ohio.

The consolidated Lubrication Activity group was established at a meeting held March 20, 1952. The purpose of this activity is to set up on balanced terms a series of groups to deal with lubricants; research, as related to lubrication; machine design, as related to lubrication; machine builders concerned with lubrication; machine operation, with respect to lubrication; and lubrication-application equipment.

The ultimate result of such activity is to consolidate the activities of the Research Committee on Lubrication, the lubrication activities of the Petroleum Division on lubrication, the lubrication activities of the Petroleum Division Application Committee, and the Lubrication Co-ordinating Committee. To date, these three committees have not functioned in as complete unison as Society interests in lubrication would warrant. It is hoped to correct this by the organization of Lubrication Activity.

A further benefit to result from this activity would be arrangement of subject matter for papers so as to be of maximum benefit to the six groups already mentioned, as well as to members in other professional divisions. Any one of these groups in time is to be free to call for the co-operation of any of the other groups with regard to development of papers, or co-operation in regard to their other activities.

All members who are interested in taking part in any of the groups covered by the Lubrication Activity are cordially invited to attend this meeting.

ASME Textile Engineering Division's Spring Conference Announced

THE Textile Engineering Division of The American Society of Mechanical Engineers will hold its spring conference at the Sheraton-Plaza Hotel, Boston, Mass., Friday, May 16, 1952.

The meeting will be devoted to the wool and worsted industry and will consist of morning and afternoon sessions and a luncheon. The meeting is open to the general public.

The technical program includes papers on wool blending, wool carding, woolen carding meets quality control, the Holdsworth Gill reducer, and the Warner-Swasey weaving machine.

The luncheon speaker will be N. M. Mitchell, Mem. ASME, president of Barnes Textile Associates, Boston, Mass.

ASME Establishes Dynamic Systems Committee

THE frequency-response approach to automatic-control problems has been simultaneously adopted by several industries as a standard tool in the solution of their control problems. One advantage of this approach is that it can be taught to technicians who do not have much advanced mathematical training, so that they can design satisfactory controls for a wide variety of problems. In the frequency-response approach, amplitude and phase curves are associated with each physical component with which the designer must be concerned. These curves are obtained for a given component with an input and an output by applying a sinusoidal input of known amplitude and frequency to the component and measuring the amplitude and phase of the output relative to the input. This is done for different frequencies. By plotting the ratio of the amplitude of the output to the amplitude of the input versus frequency, one obtains the "amplitude frequency-response curve" of the component. By plotting the phase of the output relative to the input versus frequency, the phase frequency-response curve is obtained. From the frequency-response curves of the various components of a closed-loop system the designer can determine whether or not the performance of the system will be satisfactory. If not, he can choose other components in an effort to obtain better performance. Frequency-response curves are almost as characteristic of a component or process as fingerprints are for a human being.

ASME Membership as of March 31, 1952

Honorary Members	52
Fellows	367
Members	13,272
Associates	367
Junior (33 and over)	3,063
Junior (30–32)	2,101
Junior (To the age of 29)	18,516
Total	37,738

Some engineers plot amplitude ratio versus frequency, others amplitude ratio in decibels versus the logarithm of the frequency to the base 10, and others use different co-ordinates for the amplitude frequency-response curves. There is also a considerable variation in the manner in which other frequency-response curves or derived curves are plotted and in the employment of terms and notations for treating transfer functions and other aspects of the theory. This lack of uniformity has caused much confusion. An engineer should be able to look at a frequency-response curve and know immediately what it means, without having to learn what the curve looks like in different co-ordinate systems. This need for immediate standardization of frequency-response data was perhaps the most important factor that precipitated the formation of the new "Dynamic Systems Committee" of The American Society of Mechanical Engineers, and is the immediate purpose of the committee.

Since frequency-response methods are employed in all of the major fields of engineering, an effort is being made to make the recommendations of the committee as much in line with what people are doing in other fields as possible. The recommendations of the committee will go to the Executive Committee of the ASME Industrial Instruments and Regulators Division.

Eventually the committee may compile or sponsor the publication of frequency-response curves and transfer functions for the more important components and processes in engineering, in particular, in the industrial process fields where the interests of many of the members of the committee lie. Since a given automatic-control problem will often involve all of the major fields of engineering, such as the electrical, mechanical, and chemical, the viewpoint of the committee is quite broad, and the committee has representatives from all of these fields. It is hoped that the work of the committee will give further impetus to the employment of scientific methods in the design of automatic controls.

Rufus Oldenburger, mathematician-engineer of the Woodward Governor Company, author of "Mathematical Engineering Analysis," published in 1950 by The Macmillan Company, was elected chairman of the new committee. At present he is in Europe to gather information on what designers there are doing in the frequency-response field and what their thoughts are on the presentation of data.

S. P. Higgins, Jr., development engineer, Brown Instrument Division, Minneapolis-Honeywell Regulator Company, is acting as secretary of the new committee. Other members are William Ahrendt, president, Ahrendt Instrument Company; P. S. Buckley, engineer, E. I. du Pont de Nemours & Company, Inc.; William Caldwell, director of research, Taylor Instrument Companies; G. H. Cohen, engineer, Taylor Instrument Companies; Prof. P. S. Creager, Rutgers University; G. F. Gardner, division engineer, General Electric Company; Prof. J. A. Hrones, Massachusetts Institute of Technology; A. S. Iberall, physicist, National Bureau of Standards; Marion Lofig, engineer, Shell Development Company; R. S. Lovett, engineer, E. I. du Pont de Nemours & Company, Inc.; C. E. Mason, consulting engineer, formerly with Bristol Company; C. D. Pengelley, chairman of engineering mechanics, Southwest Research Institute; R. A. Rockwell, director of engineering, Mason-Neilon Regulator Company; D. W. St. Clair, engineer, Eastman Kodak Company; W. E. Vannah, engineer, The Foxboro Company; F. A. Wood, engineer, Carbide and Carbon Corporation; E. H. Woodhull, engineer, Perkin-Elmer Company.

The Dynamic Systems Committee is receiving and hopes to continue to receive the full co-operation of the ASME membership. It is obtaining invaluable help and advice also from members and committees of other engineering societies.

RESA Establishes New Branch

THE first branch of the Scientific Research Society of America between Pennsylvania and the Pacific Coast has been established in Texas in recognition of the work of Southwest Research Institute.

George A. Baitsell, editor in chief of publications for the American Association for the Advancement of Science and professor of biology at Yale University, presided over the installation of officers March 7 for the Southwest Research Institute branch of RESA.

William V. Houston, president of Rice Institute in Houston and a trustee of SwRI, was principal speaker at a dinner in the St. Anthony Hotel preceding installation of Charles A. Culver, an authority on electroacoustics and dean of professional development at SwRI, as first president of the branch.

Several trustees of the scientific institutions at Essar Ranch and other guests attended ceremonies at which 22 charter members, all holding doctorate or master's degrees, were sworn into the new RESA unit.

In addition to Dr. Culver, other elected officers included John Loefer, research biologist of the Southwest Foundation for Research and Education, vice-president; John C. Cook, SwRI physicist, secretary; and Fred Koebel, SwRI mechanical engineer, treasurer.

Membership in RESA is based on demonstrated research ability and published results, while its primary purpose is to encourage original investigation in science, pure and applied.

Dr. Baitsell is national treasurer of RESA and Dr. Karl T. Compton, national chairman.

People

G. F. CARRIER, Jun. ASME, was appointed as Gordon McKay professor of mechanical engineering at Harvard University. Dr. Carrier is professor of mechanical engineering at Brown University, where his work has been in applied mechanics.

* * *

T. E. MURRAY, Fellow ASME, president, Metropolitan Engineering Company, and member of the U S. Atomic Energy Commission, was named as the 1952 recipient of the Laetare Medal, awarded annually since 1883 by the University of Notre Dame to an outstanding United States Roman Catholic layman.

* * *

K. J. DEJUHASZ, Mem. ASME, professor of engineering research at the Engineering Experiment Station of The Pennsylvania State College, at present on leave of absence and serving as scientific consultant with the Department of the Army in Europe, stationed at Heidelberg, Germany, has been awarded the Certificate of Appreciation for patriotic civilian service to the Department of the Army.

* * *

R. G. OWENS, Mem. ASME has been named dean of engineering at Illinois Institute of Technology. He replaces Dr. Rettaliata who was recently named president.

* * *

J. D. COLEMAN, of Dayton, Ohio, executive of the Frigidaire Division of General Motors Corporation, was elected president of the National Society of Professional Engineers. C. Y. Thomas, Mem. ASME, vice-president, Spencer Chemical Company, Pittsburg, Kan., was elected vice-president to represent the North Central area of NSPE.

* * *

L. B. BELLAMY, Detroit manager, Sterling Grinding Wheel Division, Cleveland Quarries Company, was elected president of the American Society of Tool Engineers for 1952–1953, on March 20, 1952, during the society's 20th annual meeting.

* * *

A. D. BAILEY, past-president and Hon. Mem. ASME, former vice-president of Commonwealth Edison Company, Chicago, Ill., was recently honored by the Illinois Institute of Technology when he was presented with an honorary doctor of engineering degree.

* * *

H. T. HEALD, Mem. ASME, chancellor of the New York University, was awarded the annual Washington Award for 1952 by a joint committee of the American Society of Civil Engineers, The American Society of Mechanical Engineers, the American Institute of Electrical Engineers, the American Society of Mining and Metallurgical Engineers, and the Western Society of Engineers, at a dinner held in Chicago, Ill., April 21, 1952. J. T. Rettaliata, Mem. ASME, president, Illinois Institute of Technology, represented ASME at the dinner.

* * *

P. A. HOLLAR, Mem. ASME, American Car and Foundry Company; F. X. Gilg, Mem. ASME, The Babcock & Wilcox Company; R. M. Hatfield, Jr., Mem. ASME, Combustion Engineering—Superheater, Inc., Thomas Kaveny, Jr., Mem. ASME, Herman Pneumatic Machine Company; E. W. Palmer, Assoc. ASME, Kingsport Press, Inc.; H. W. Robb, Mem. ASME, General Electric Company; and M. M. Smith, Mem. ASME, E. W. Bliss Company, were among the 188 businessmen who served without compensation to help the United States set up its defense-production program, who were honored in Washington, D. C., with a special luncheon and the presentation of "certificates of service."

* * *

W. F. THOMPSON, vice-president, ASME, Region I, vice-president, Westcott & Mapes, Inc., New Haven, Conn., was recently elected to honorary membership in Pi Tau Sigma, the national honorary mechanical-engineering fraternity.

* * *

W. E. IRVING, "father" of the grating industry, president and founder of the Irving Subway Grating Company, Long Island City, N. Y., and Oakland, Calif., received a framed scroll, presented by the Open Steel Flooring Institute. The award was made in recognition of the 50th anniversary of his company and the start of the $50,000,000-a-year grating industry.

* * *

E. G. BAILEY, past-president and Fellow ASME, and L. E. Grinter, Mem. ASME, were appointed as members of the Committee on Equipment and Supplies of the Department of Defense Research and Development Board of the Department of Defense. Mr. Bailey, vice-president of The Babcock & Wilcox Company, New York, N. Y., became associated with the committee as chairman of its Panel on Mechanical Equipment in May, 1949. Dr. Grinter, research professor of civil engineering and mechanics, Illinois Institute of Technology, has served the committee since May, 1949, as chairman of the Panel on Heavy Equipment and Engineering Construction.

* * *

H. R. KESSLER, vice-president, ASME, Region II, manager, Republic Flow Meters Company, New York, N. Y., will represent ASME at the inauguration of Dr. Lewis Webster Jones as president of Rutgers University on May 8, 1952.

* * *

J. H. HILDEBRAND was selected as the first recipient of the Scientific Apparatus Makers Award. At the University of California, where he has spent 40 years, he has served as dean of men, dean of the college of letters and science, and last year concluded a period as dean of the college of chemistry.

Meetings of Other Societies

May 12–14
Liquefied Petroleum Gas Association, annual convention and trade show, Palmer House, Chicago, Ill.

May 22–23
Institute of Radio Engineers, symposium on electronics and machines, Palmer House, Chicago, Ill.

May 22–24
American Society for Quality Control, sixth annual convention, Onondaga County War Memorial Auditorium, Syracuse, N.Y.

May 28–29
Pennsylvania Electric Association, Prime Movers Committee spring meeting: Tidewater Inn, Easton, Md.

May 28–June 7
Conférence Internationale des Grands Réseaux Électriques, 14th congress, Paris, France

June 1–6
Society of Automotive Engineers, summer meeting, Ambassador and Ritz-Carlton Hotels, Atlantic City, N. J.

June 4–10
Fourth International Mechanical-Engineering Congress, Gillet Hotel, Stockholm, Sweden

June 9–14
American Petroleum Institute, midyear standardization conference, Brown Palace Hotel, Denver, Colo.

June 16–20
American Society of Civil Engineers, Denver convention, Cosmopolitan Hotel, Denver, Colo.

June 16–20
American Electroplaters' Society, 39th annual convention, Conrad Hilton Hotel, and industrial finishing exposition, International Amphitheatre, Chicago, Ill.

Sept. 3–13
Centennial of Engineering, Chicago, Ill.
(For ASME Calendar of Coming Events see page 419)

RUFUS OLDENBURGER, Mem. ASME, engineer, Woodward Governor Company; chairman, ASME Dynamic Systems Committee, was invited to give a series of lectures on "Mathematical-Engineering Analysis" before the Institution des Arts et Metiers, Société d'Electronique et d'Automatisme, Société des Radioelectricians, and the Société Française des Mecaniciens in Paris.

Missouri Honors Engineers

THE Missouri Honor Awards for distinguished service in engineering were presented to three noted engineers and a governmental agency at the second annual Engineers' Convocation at the University of Missouri, on March 22, 1952. The convocation climaxed the annual observance of Engineers' Week.

H. O. Croft, Mem. ASME, dean of the Missouri College of Engineering, presented bronze medals and certificates for outstanding achievement to C. A. Thomas, president, Monsanto Chemical Company; Gen. L. J. Sverdrup, consulting structural engineer and noted military engineer; and Wilfred Sykes, Mem. ASME, of Chicago, Ill., chairman of the executive committee of the Inland Steel Company; and A. V. Astin, acting director, National Bureau of Standards, who accepted the award on behalf of the Bureau.

Queen City of the Pacific Northwest Welcomes 1952 ASME Spring Meeting

More than 500 Attend Three-Day Meeting in Seattle

THE newly completed University of Washington Student Union Building served as an appropriate setting for The American Society of Mechanical Engineers' 1952 Spring Meeting held March 24-26, which was attended by large and enthusiastic audiences. A varied program of technical sessions, plant trips, and social activities was offered by the Western Washington Section of the ASME, who were hosts at the meeting. Also at this meeting Region VII held its 1952 Regional Administrative Committee Meeting to discuss the problems and policies of ASME.

Reflected in many comments that were heard during the technical discussions and at the luncheons and banquet was the fact that the Pacific Northwest is rapidly becoming an important industrial area. The magnificent stands of timber are not only beautiful to see—they are the foundation of the vast lumber industry for which the Pacific Northwest is already well known. Water sheds, long known to fishermen and all lovers of the great outdoors, are today gaining new fame in the production of vast amounts of hydroelectric power. One thought was paramount. It was that the natural reserves of the area and its ever-increasing population present a challenge to the imagination and ingenuity of the engineering profession. Many problems must be solved and many projects undertaken before the full value of the Pacific Northwest can be realized by the nation.

President's Luncheon

Conant Dodge, chairman, ASME Western Washington Section, Region VII, presided at the President's luncheon held Monday.

The Hon. A. B. Langlie, governor of the State of Washington, delivered the address of welcome. In his message to a group of more than 200 members and guests, Governor Langlie stated that the State of Washington does not have enough engineers to conserve and develop resources of the state to meet the constantly mounting problems.

Engineering must concern itself with a cost and benefit study, he said. "I hope that you will take a vital interest in the affairs of the government and the policing of government projects and undertakings to the point where we evaluate them from the standpoint of long-range return," Governor Langlie concluded.

The principal speaker for the President's luncheon was President R. J. S. Pigott. His subject was "Are We Self-Supporting in Energy Supply?" President Pigott began by discussing the nonreplenishable resources such as coal, petroleum, oil shale, and natural gas. Estimates of the quantities available at the present rate of consumption vary from 2700 years to 275 years. He stated that the correct figure lies somewhere in between, but rather closer to the minimum figure. Since there is only approximately $^1/_{10}$th as much petroleum resources as coal he concentrated his attention primarily on that area. Liquid fuels have attained a position of great importance because of their greater mobility and convenience.

Pessimistic estimates of the petroleum resources within the United States place them at about a ten-year supply. However, President Pigott stated that this estimate was not valid since it was based on an oversimplified formula. The ratio of known resources to annual consumption has remained in the vicinity of ten years ever since 1937. The reason for this is that all resources are not known, wells are going deeper, and the drillers are employing greater recovery economics. Although the situation is not as serious as these figures would lead us to believe, the problem is still important to the United States since we produce 60 per cent of the petroleum in the world.

He suggested several alternatives for orthodox fuels such as the sun, air and tide energy, hydroelectric power, and synthetics. All of these alternatives are feasible but have certain inherent disadvantages. Cost, mobility, efficiencies are several drawbacks, but President Pigott pointed out that their effect will be minimized as prices of conventional fuels rise and improved technology makes lower costs possible.

"At the present time we have no serious shortage because we shall replace it in time. However, the warning is right up on the wall; we had better do something about it continuously from now on," President Pigott concluded.

Technical Program

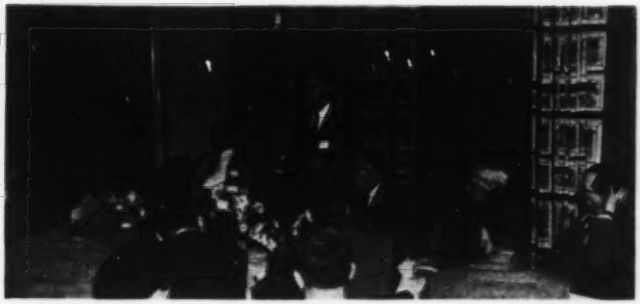
The technical program comprising 45 papers, presented by 51 authors at 17 technical sessions, was sponsored by 13 professional divisions of the Society. Papers covered the following fields: aviation, heat transfer, power, materials handling, wood industries, fuels, nuclear energy, machine design, metals engineering, gas-turbine power, management, applied mechanics, and hydraulics.

Sixteen digests of available 1952 ASME Spring Meeting papers appear on pages 405-411 of the ASME Technical Digest section in this issue. Digests of remaining papers will be published in forthcoming issues of MECHANICAL ENGINEERING. Some of the papers will also be published in full in MECHANICAL ENGINEERING and ASME Transactions.

Pamphlet copies of the preprints are available from the ASME Order Department, 29 West 39th Street, New York 18, N. Y. When

THE PRESIDENT'S LUNCHEON AT THE 1952 ASME SPRING MEETING

(*Left to right:* Secretary C. E. Davies; Vice-President of Region VII S. H. Graf; President R. J. S. Pigott; Conant Dodge, Chairman ASME Western Washington Section; H. P. Everest, Vice-President, University of Washington; and Past-President J. Calvin Brown.)



DR. B. M. WOODS DELIVERING THE ROY V. WRIGHT LECTURE

ordering, please give title, author, and paper number. Price, 25 cents per copy to ASME members.

Roy V. Wright Luncheon Lecture

The speaker for the Roy V. Wright luncheon was Dr. Baldwin M. Woods, professor of mechanical engineering and director of the University of California Extension Division.

In his address, "The Engineer's Civic Responsibility—an Action Program," Dr. Woods stated that the engineer has four citizenships: community, state, nation, and world. A man has all four of these citizenships at once. "I don't know any more challenging task than getting some set of criteria for harmonizing them," he said.

The engineer's role in society cannot be underestimated. "The engineer's civic responsibility calls for him to take action along the lines of a program that only he himself can build," Dr. Woods observed.

Banquet

The main social event of the meeting was the banquet, which was held on Tuesday night in the Student Union Building banquet room. More than 200 members and guests attended to hear Roderic Olzendam, director of Social Security for the State of Washington, speak on "Human Engineering." Prof. H. J. McIntyre of the University of Washington mechanical-engineering faculty, made the opening remarks and introduced the toastmaster, Prof. E. O. Eastwood of the University of Washington. Professor Eastwood introduced the men seated at the head table, and presented Mr. Pigott, who urged engineers to take a more active interest in politics. Professor Eastwood then introduced Mr. Olzendam.

Human engineering was defined by Mr. Olzendam as "the science of purposeful planning to achieve a goal. The goal is the improvement of man's relationship to man." He attacked the problem by first examining what has been said before on human relations.

He listed three fundamental facts: (1) Man is a human being; (2) he is an individual, and therefore no two human beings are exactly alike; and (3) he is a member of the human race—one of the 2,400,000,000 increasing at the rate of approximately 70,000 a day.

Mr. Olzendam then went on to discuss "human"—explaining that man, while he was created in the image of God, has a second nature. With the ability to reason, man was given the power to choose between good and evil. Therefore the human element is contradictory and unpredictable, and man may choose to follow a certain course on one day only to make an exactly opposite choice another day.

In discussing the term "engineering," Mr. Olzendam stated that formulas and logical reasoning are the engineers' tools, and that an engineer is essentially a creative human being. An engineer uses an orderly arrangement of thought and formulas because he has found from experience that the reaction of the materials with which he works can be predicted.

Mr. Olzendam said that part of the problem of human engineering is predictable, and the other part is quite unpredictable. In his search for a simple formula for the problem, he drew from the Ten Commandments, the Sermon on the Mount, the United States Constitution, and the Gettysburg Address. After discussing several points in each of these famous documents, he stated that: "Our experience as human beings indicates that we are distinctly individual and there is no formula that can be used to apply to humanity at large, as we do in science."

The goal of human relations should be composed of fundamental conditions that will appeal to all individuals so that they will all have a feeling of belonging, and striving for a common goal.

"We seem to have diluted our concepts of imagination, character development, quality, depth of understanding, the qualities of the human soul. Human engineering is the process of learning and developing these qualities in the relationship of one man with another," Mr. Olzendam said.

He stated further that if men would recognize the instincts for self-preservation, security, freedom, justice, and comradeship in all mankind, the result would be a constructive "world revolution in the production of material and spiritual wealth."

Mr. Olzendam concluded his talk with the statement that "the only ism that has any hope of achieving man's salvation as man is Americanism."

Inspection Trips

Two important Seattle industries were hosts to more than 100 ASME members and their guests. Tuesday afternoon the United States Plywood Company showed many interesting phases of plywood manufacturing from the peeling of logs and the feeding of hot presses

AFTER THE BANQUET

(*Left to right:* Dean H. E. Wessman, E. O. Eastwood, Roderic Olzendam, President R. J. S. Pigott, and H. J. McIntyre.)

to the sanding and trimming of finished panels. Much of the 400,000-sq-ft capacity of this Seattle plant is devoted to Douglas Fir and Philippine mahogany plywood. Door-manufacturing operations and shipping facilities were explained to an interested audience by plant officials.

Also on Tuesday afternoon there was a trip to inspect the facilities of the Renton plant of Pacific Car and Foundry Company. Situated on Pacific Car's 51-acre site just south of Seattle is the second largest foundry west of the Mississippi. Those who attended this trip were fortunate enough to see nearly all foundry operations in action.

The large forge shop and one of the most complete production machine shops in the Northwest, which are part of Pacific Car and Foundry Company, were included. The railroad-car production line with its facilities for producing 11 refrigerator cars a day, and the bus and delivery truck-body plant, were also shown during the inspection trip.

The Women's Program

The women's program was pleasantly varied and enjoyable. Monday the ladies were taken on a tour of Seattle which included visits to Woodland Park, the city's zoo; the Government locks; the Ballard fishing fleet, which had received its traditional benediction the day before; and the water front where a troopship from Korea was docking.

From the water front the women were taken across the Lake Washington Floating Bridge, for a drive through the residential districts on the lake front and then to Volunteer Park for a view of the city and harbor at sunset.

Tuesday the women either accompanied their husbands on the field trips or else spent the day "doing the stores downtown."

A no-host luncheon on Wednesday at the new Frederick and Nelson tearoom was enjoyed by the women and served as a finale to their program. During the luncheon, selections from several European couturiers' collections were modeled.

The women's program was arranged by Mrs. Otis F. Lamson, Jr., who was ably assisted by Mrs. Carl Crumb, Jr., and Mrs. Peter Koch.

Committees

The general committee for the 1952 ASME Spring Meeting was headed by H. J. McIntyre, professor of mechanical engineering, University of Washington, who served as chairman. Vice-chairman B. D. Mills and secretary W. B. Nordquist aided Professor McIntyre in the work of this committee.

R. H. Bacon, chairman of the Meetings Committee, was assisted by J. H. Davis, R. W. Flynn, J. K. Louden, A. W. Thorson, T. A. Marshall, Jr., G. R. Fryling, and H. D. Moll. Chairman E. E. Day, in charge of technical events, had on his committee D. Hage, Peter Balise, N. Sardin, A. Schrieber, and C. Plumb.

T. A. Gaynor, Jr., inspection-trip chairman, was assisted by J. Alberty, H. Bushley, T. Berhard, E. Lowry, and Ira Dye. R. P. Krause acted as chairman of the printing and signs committee. O. F. Lamson, Jr., was in charge of the entertainment. Handling the details of registration and ticket sales was Prof. W. W. Philbrick. Other members of the registration committee included Michael Guidon, 3rd, Prof. R. Messer, Donald Avery, and D. Gjorsdahl.

Hotel arrangements were handled by W. K. Watson, chairman, and D. R. Stephens. The reception committee included chairman F. B. Lee, Ira Dye, R. Dyer, F. Browning, W. Beggs, F. Bloombery, F. Greaves, W. Hill, and F. Nicholsen. Matter of finance for the Spring Meeting was handled by R. W. Beach. Mrs. O. F. Lamson, Jr., arranged the program of women's events. She was aided by Mrs. Peter Koch and Mrs. Carl Crumb, Jr.

Prof. R. W. Crain, Sr., and Prof. J. B. Morrison were in charge of the banquet and luncheons program.

Chairman L. B. Zylstra of the Publicity Committee was aided by A. R. Konecney and E. R. Conmer. Donald R. Reightley, Allen R. Miller, and James S. Eastman covered the meeting for MECHANICAL ENGINEERING and Edward S. Wright handled the photography for the meeting.

Conservation of Materials—Men—Time Theme of Pittsburgh Mechanical-Engineering Conference

DISCUSSIONS centering about the conservation of strategic metals, more effective utilization of technical manpower, and ways of increasing productivity were featured on the program during the sixth annual Mechanical-Engineering Conference, held in Pittsburgh, Pa., March 18 and 19. The meeting was sponsored by the Pittsburgh Section of The American Society of Mechanical Engineers in co-operation with the Mechanical Section of the Engineers Society of Western Pennsylvania, American Material Handling Society, American Society of Heating and Ventilating Engineers, American Society of Lubricating Engineers, American Society of Refrigerating Engineers, National Association of Corrosion Engineers, and the Westmoreland Section of ASME.

Banquet

The more than 250 in attendance at the banquet Tuesday evening heard Phillip M. McKenna, Mem. ASME, president, Kennametal, Inc., Latrobe, Pa., and national chairman, The Gold Standard League, urge a return to the gold-coin standard of money with convertibility to the American citizen. He said that if we restore a sound currency to the people, our prosperity will grow and we can have activity in borrowing and lending for worth-while enterprises creating real values giving worth to the dollar. R. J. S. Pigott, president ASME, acted as toastmaster.

Strategic Metals Discussed

Highlighting the conference was a panel meeting on Tuesday morning, covering strategic metals, their conservation, or the use of alternatives. H. C. Amtsberg, manager, metallurgical engineering, Westinghouse Electric Corporation, East Pittsburgh, Pa., examined the copper, tin, and lead picture. Copper supplies, he said, cannot last for another 50 years at the present rate of consumption—and in the case of wartime—estimated reserves range from 30 to 50 years. While the U. S. is the world's largest producer of copper—900,000 tons per year—it must still import an additional 500,000 tons. This results in a not-too-healthy outlook, especially if our imports are cut off.

Mr. Amtsberg pointed out that the U. S. is the largest user of tin—yet produces practically none. Cutting off supplies of this metal would provide a serious problem and substitutes must be found.

As for lead, he said there are no restrictions and lead is now in plentiful supply. However, he continued, this is a short-term picture.

D. A. Griffith, assistant to manager, Pittsburgh Works, Allis-Chalmers Manufacturing Company, formerly member of Defense Production Authority Board, speaking on the shortage of these metals and their effect on production, emphasized that, where at all practicable, do not use tin if possible. As for copper, he said, a real shortage exists, especially in certain shapes and sizes of the metal. However, aluminum is being substituted for copper in such industries as the electrical and automotive.

Discussing the nickel and cobalt situation, F. A. LaQue, director of research, International Nickel Company, New York, N. Y., said that the nickel supply for civilian use depends, of course, on the international situation. Also that scrap is an important source of nickel at this time. To alleviate the nickel shortage, alloys are being substituted or in some cases nickel is not being used at all.

Cobalt supplies, according to Dr. LaQue, are not too tight at this time. New operations are under way and many conservation measures have been instituted.

G. A. Roberts, metallurgist, Vanadium Alloys, Latrobe, Pa., reviewing the vanadium, molybdenum, and tungsten metals and their effect on industry, cited their importance as alloying elements, in die materials and machining operations. Supplies of tungsten, he said, are located all over the world, principally in the U. S. and Asia. Tungsten is consumed mainly in the high-speed-steel field, carbide-tool field, and in high-temperature alloys. However, tungsten can be replaced by moly in high-speed steels and in high-temperature alloys. Vanadium, he said, is in plentiful supply. Its principal uses are in the high-speed-steel field, and now in all phases of the tool-steel industry.

Vanadium, Dr. Roberts pointed out, can be substituted for moly in castings when moly is short. Also the substitution of vanadium in high-speed steels will conserve our tungsten and moly supplies.

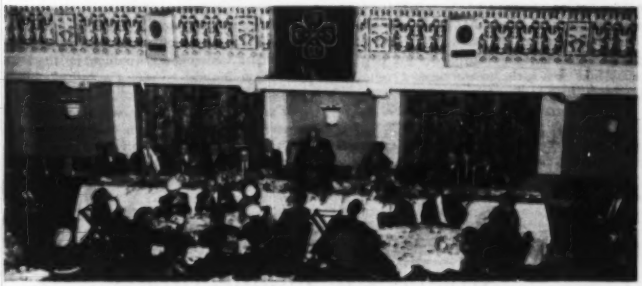
A much brighter picture exists for aluminum and magnesium, according to John A. Willard, chief development engineer, Aluminum Company of America, Pittsburgh, Pa. The end to any shortages is in sight because of cutbacks in aircraft production and military demands, in general. "Unless the military program changes," he said, "the future aluminum supply seems adequate for both military and civilian needs."

Turning to the over-all problem, R. B. Smith, Mem. ASME, vice-president, M. W. Kellogg Company, New York, N. Y., pointed out that although much publicity has been given to the shortage of critical materials, it is significant that in many aspects our military rearmament program is today being delayed by lack of productive tools more than by raw materials. There is also evidence that shortly we may be faced with a serious deficiency of technically trained personnel for the execution of our accelerated programs, he said.

Conservation is a problem of challenging magnitude to the whole engineering profession. It is a gigantic problem in management and planning, requiring the best in initiative, ingenuity, and judgment. Except in the field of labor conservation, where economic pressure has arisen, Americans as a group have been profligate in their use of raw materials. Their abundant supply within our borders has not forced the same outlook on conservation among American technical men that one finds in the profession as practiced on the continent. Even economic readjustments, Mr. Smith said, such as we have experienced since Korea, or during the last war, have been attacked on a transient basis; witness, for instance, the confused and contradictory pronouncements from present-day Washington on probable material shortages.

Technical Manpower

At sessions covering technical manpower, Tuesday afternoon, T. A. Marshall, Jr., Mem. ASME, executive secretary, Engineering Manpower Commission of Engineers Joint Council, reviewed the work of the Commission, its programs, and progress. Gen. C. S. Dargusch, attorney at law, Columbus, Ohio, formerly deputy director, National Selective Service Headquarters, speaking on implications of our manpower mobilization, covered the Selective Service Program, Reserve Officer Act, and college-student deferments.



P. M. MC KENNA ADDRESSES SIXTH ANNUAL PITTSBURGH MECHANICAL-ENGINEERING CONFERENCE BANQUET

Increasing Productivity

Subjects covered at the Increasing Productivity session Wednesday morning, included, "Wages and Incentive Plans," by M. W. Lewis, chief industrial engineer, U. S. Steel Company, Pittsburgh, Pa.; "Material Handling, A Case History of Increased Production," by Frank Wier, superintendent of material handling, Timken Roller Bearing Company, Canton, Ohio; and "Efficiency in Man-Machine Systems," by R. B. Miller, project director, American Institute for Research, Pittsburgh, Pa.

On Wednesday afternoon, a group, as guests of the Gulf Oil Company, inspected the facilities of the Gulf Research and Development Laboratory at Harmarville, Pa.

Centennial of Engineering Launched

American Power Conference Opens Six-Month Celebration

THE six months of national and international ceremonies, stage presentations, spectacular exhibits, and other special events in Chicago, Ill., that will highlight the celebration of the Centennial of Engineering, was opened by the American Power Conference, which was held at the Sherman Hotel, March 26-28.

Designation of the big gathering of the country's leaders in power production, transmission, and utilization as the "opening gun" in Chicago of the Centennial was made by L. R. Lohr, the Centennial's president. The 50th National Power Show and the annual meeting of the National Association of Power Engineers was held at the Sherman, concurrently with the Power Conference.

Sponsored by the Illinois Institute of Technology, the American Power Conference was staged with the co-operation of Northwestern, Purdue, Iowa, Illinois, Michigan, Wisconsin, and Minnesota Universities, Iowa State and Michigan State Colleges, the Edison Electric Institute, and a wide group of engineering societies and public-utility companies.

Speakers at the various meetings during the conference included such national figures as W. J. Grede, president, National Association of Manufacturers; Claude Robinson, president, Opinion Research Corporation; L. J. Brown, director of public relations, American Medical Association; C. H. Lang, vice-president, General Electric Company; G. M. Gadsby, president, Edison Electric Institute; and the presidents of important public-utility and industrial concerns from coast to coast.

As the Centennial program progresses over the next half year, similar meetings by other major technical, scientific, and engineering groups will occur, including the ASME Fall Meeting, Sept. 8-11, 1952, at the Hotel Sheraton, culminating with a 10-day international convocation in Chicago, starting September 3. During the September assembly 51 American engineering societies and several from Europe, Latin America, and the Far East will hold meetings in Chicago that are expected to attract a collective attendance of more than 25,000 from all over the engineering world.

More Engineers Needed

Stating that America's colleges and technical schools are preparing only about half as many trained engineers as the country needs, L. R. Lohr announced that one of the main objectives of the Centennial of Engineering will be to inspire more young men and women to take up engineering as a career.

Serving with Mr. Lohr as Centennial directors are such figures as Herbert Hoover, Hon. Mem. ASME, and Charles F. Kettering, Fellow ASME, research wizard of the General Motors Corporation.

"Due to unfortunate prophesies a few years ago that there would be an oversupply of engineers, student enrollment has dropped alarmingly below what we need to maintain the pace of our American industry," Mr. Lohr said. "Conservative estimates indicate the requirements of industry in 1954 will be at least 32,000 new engineering graduates, with 64,000 needed in 1960. Yet the U. S. Office of Education reports that only 17,000 will come out of 1954 classes; while the Engineering Manpower Commission makes the more pessimistic prediction that the collegiate output that year will not total 12,400 engineering graduates.

"Actually, today the demand for mechanical engineers, electronic engineers, metallurgists, and other technical specialists is little short of hysterical. One American company alone has an immediate need for 2000 engineers and scientists who are not available."

Engineer Backbone of Mass Production

The engineer is the backbone of mass production, for the number of units is so large that every step of manufacture must be engi-

Important Notice to ASME Members

IF YOU are planning to attend the Centennial of Engineering to be held in Chicago, Ill., Sept. 3-13, 1952, during which time the ASME Fall Meeting will be held, Sept. 8-11, make your hotel reservations *without delay*. The Hotel Sheraton will be ASME headquarters.

neered to save a fraction of a cent here and save a second of time there, Mr. Lohr explained. This evolution from the small shop to the great plants of today has occurred in the past 50 years, and with it the greater need of technical guidance, he added.

In 1900 there was one engineer to 290 industrial workers; in 1950 it was one to 70. During the last 60 years the number of engineers has increased from 25,000 to 400,000 with the possibility that the demand may be doubled in another ten years.

"If our industrial progress is to continue and we are to maintain our dominant position in world affairs, all constructive steps, such as the coming Centennial, should be utilized to persuade young men to have a technical education," Mr. Lohr said.

"The rapidly accelerating pace of the modern industrial world demands more technical knowledge, imagination, and resourcefulness. Our progress is an inverted pyramid, with each level requiring an ever-increasing number of scientists and engineers."

SWE 1952 Convention Stresses Recent Advances in Engineering

Greater Professional Status for Engineering Urged

THE Society of Women Engineers held its second annual national convention, its fourth annual conference, at the Statler Hotel, New York, N. Y., March 15–16, 1952.

"To induce a steady flow of engineers to supply the needs of industry which are increasingly evident, engineering will have to demonstrate that it can offer opportunities as promising as other professions for job security, job satisfaction, and financial return," according to B. A. Hicks, president, Society of Women Engineers, and vice-president and chief engineer of Newark Controls Company, Bloomfield, N. J.

The need for the conscious advancement of engineering as a profession was the subject of Miss Hicks' welcoming address to the opening session of the convention of the society.

FIRST PRESENTATION OF THE SOCIETY OF WOMEN ENGINEERS' AWARD FOR MERITORIOUS CONTRIBUTION TO ENGINEERING AT THE ANNUAL BANQUET OF THE 1952 NATIONAL CONVENTION OF THE SOCIETY HELD AT THE HOTEL STATLER, NEW YORK, N. Y., MARCH 15

(*Left to right:* W. F. Traendly, publisher, *Chemical Week* and *Chemical Engineering*, dinner speaker; Miss B. A. Hicks, president of the society and vice-president and chief engineer, Newark Controls Company, Bloomfield, N. J.; Dr. Maria Telkes, recipient of the award; Mrs. D. R. Young, dean of women at Drexel Institute of Technology, who made the award and was chairman of the Selection Committee.)

Miss Hicks' speech presented one aspect of the development of the over-all convention theme, "Recent Advances in Engineering."

Miss Hicks quoted recent estimates of a need for 30,000 new engineers each year by the government and industry, a figure which is from 35 to 100 per cent higher than the number of students who will be graduated from our engineering colleges in each of the next five years. Miss Hicks was of the opinion that there are two ways of meeting this situation of increasing shortages: One, to establish and maintain professional engineering standards of such quality that qualified students, both men and women, will be encouraged to select engineering as a profession; alternatively, to accept and carry marginal talent in the engineering fields.

At a symposium following Miss Hicks' talk, three speakers described some recent technical advances in engineering as further development of the theme.

The almost limitless possibilities for large-scale use of aircraft in new and unusual ways were presented by Miss Katherine Stinson, chief, specifications staff, Aircraft Division, U. S. Civil Aeronautics Administration, Washington, D. C. Miss Stinson pointed out unsolved problems in her field which are challenging the imagination and abilities of engineers. Miss Stinson also stated that the airplane now is in a period when its use is being extended into the areas of human welfare, discovery, agriculture, politics, and even into geography, both the geography of our world and of the universe.

The trend toward verifiable measurement in industrial engineering and its operational consequences was described by D. B. Herz, Jun. ASME, director, Center for Studies of Research Administration, School of Engineering, Columbia University, New York, N. Y. Dr. Herz predicted other changes in the science of industrial engineering, in terms of increased efficiencies and greater production.

The development of industrial hygiene as a new application of engineering science was the topic of the third symposium speaker, A. C. Stern, Mem. ASME, chief, engineering unit, Division of Industrial Hygiene and Safety Standards, New York State Department of Labor, New York, N. Y. He cited examples of the advances made in the safe use of toxic materials. "Whenever you stop at a gasoline pump to buy a tankful of catalytically cracked ethyl gasoline," Mr. Stern said, "you are doing so through the efforts of the industrial hygienists, physicians, and engineers, who tamed the toxicity of the material used."

Incorporation of the Society

Following the symposium, an open membership meeting was held at which the various committees reported on their activities during the past year. The high light of the meeting was the presentation of the certificate of incorporation of the Society of Women Engineers in Washington, D. C., to Miss Hicks by Miss Stinson, chairman of the Incorporation Committee.

Forecast for the Process Industries

At the annual banquet held March 15, Wallace Traendly, publisher of *Chemical Engineering* and *Chemical Week*, stressed the part

played by chemical engineering in the development of the petroleum, synthetic fibers, paints, and varnish industries as well as in the production of chemicals. Mr. Traendly covered the growth prospects for the broad group of chemical process industries as compared with industry as a whole.

First Presentation of SWE Award

The first presentation of the Society of Women Engineers' Award for meritorious contribution to engineering was made at the dinner.

The recipient of the award was Dr. Maria Telkes, research associate in metallurgy at the Massachusetts Institute of Technology. During World War II she served as civilian adviser to the Office of Scientific Research and Development, devoting her efforts to the design of a distilling system using solar heat to convert sea water to drinking water. In 1945 she received a certificate of merit from OSRD for this development.

Future Engineering Education

On March 16 guest speakers and members participated in a panel discussion on "How Do Engineering Schools Prepare the Student for Positions in Industry?" led by I. P. Orens, chairman, Graduate Division, the Newark College of Engineering, Newark, N. J. The panel members included: Miss Eve Rossell, director, personnel management service, New York, N. Y., and lecturer in personnel administration, school of engineering, Columbia University, New York, N. Y.; Aimison Jonnard, senior technologist, economic research department, Shell Chemical Corporation, New York, N. Y.; B. H. Saltzer, Mem. ASME, supervisor, engineering recruiting and training, Wright Aeronautical Division, Curtiss-Wright Corporation, Woodridge, N. J.; and William Hazell, dean of administration, Newark College of Engineering, Newark, N. J.

The members of the panel had been chosen to present the points of view of personnel, management, industry, and education. Among the questions presented to the members was this one inquiring into the advisability of allowing students a greater freedom in choice of electives, in an attempt to keep pace with the new advances in the engineering fields; or giving the student a general engineering education in preference to specialization.

1952 ASME Applied Mechanics Division Conference to Be Held June 19–21

Penn State Headquarters for 17th Annual Conference

THE 17th National Applied Mechanics Division Conference of The American Society of Mechanical Engineers, featuring the Symposium on Shock and Vibration Instruments, will be held June 19–21, 1952, at The Pennsylvania State College at State College, Pa., with the co-operation of the ASME Central Pennsylvania Section.

The technical program will be presented at ten sessions and an inspection trip to the Garfield Thomas Water Tunnel of the Naval Ordnance Laboratory has been arranged for June 20, from 5:00 to 6:00 p.m. The other laboratory and research facilities of the College will be open for inspection throughout the conference, but no formal tours are planned. Lists of the places open and the nature of the work being conducted will be available at the time of registration. A women's program is also arranged.

The ASME Registration Desk will be located in the lobby of the electrical-engineering building. Conferees may register any time between 8:30 a.m. and 7:00 p.m., June 19; 8:30 a.m. and 4:00 p.m., June 20; and 8:30 a.m. and 1:30 p.m., June 21. A conference fee, $1 for members and $2 for nonmembers, entitles the registrant to attend all sessions and to the usual preprints which appear in the *Journal of Applied Mechanics*. The conference-symposium fee, $3 for members and $4 for nonmembers, includes the afore-mentioned plus preprints of the symposium papers and a copy of the final Symposium Proceedings, including discussions, to be mailed at a later date. The symposium papers will not be a part of the regular ASME Transactions.

The tentative program follows:

THURSDAY, JUNE 19

9:30 a.m.

Session I

An Airy Integral Analysis of Beam Columns With Distributed Axial Loading Having a Fixed Line of Action, by *C. M. Tylor*, assistant professor, mechanical engineering, Carnegie Institute of Technology, Pittsburgh, Pa., and *J. G. Christiano*, department of mathematics, University of Pittsburgh, Pittsburgh, Pa.

A Photoelastic Re-Examination of Notched Tension Bars and a Comparison of the Results With Those of Neuber and Chih-Bing Ling, by *M. M. Frocht*, research professor of mechanics, and *D. Lansberg*, department of mechanics, Illinois Institute of Technology, Chicago, Ill., and *R. Guernsey, Jr.*, associate professor, engineering mechanics, University of Texas, Austin, Texas

The Elastic Sphere Under Concentrated Loads, by *E. Sternberg*, professor, mechanics, Illinois Institute of Technology, Chicago, Ill., and *F. Rosenthal*, associate research engineer, Armour Research Foundation, Chicago, Ill.

(By Title)* **On the Stresses in a Notched Strip,** by *Chih-Bing Ling*, senior research officer, Aeronautical Research Laboratory, Taiwan, China

(By Title)* **Stresses in a Rotating Disk of Variable Thickness,** by *Ti-Chiang Lee*, research engineer, Aeronautical Research Laboratory, Taiwan, China

(By Title)* **The Torsion of Uniform Rods With Particular Reference to Rods of Triangular Cross Section,** by *H. Nuttall*, lecturer, mechanical engineering, The University, Birmingham, England

9:30 a.m.

Session II

Investigation of Annular Liquid Flow With Concurrent Air Flow in Horizontal Tubes, by *A. E. Abramson*, aeronautical research scientist, Lewis Flight Propulsion Laboratory, NACA, Cleveland, Ohio

Pressure Drops in the Pneumatic Conveyance of Solids by Gases, by *Oscar Pinkus*, test engineer, General Electric Co., Schenectady, N. Y.

A Study of Vanes Singing in Water, by *C. A. Gongwer*, manager, Underwater Engine Division, Aerojet Engineering Corp., Azusa, Calif.

Optimum Single Propellers in Radially Varying Incompressible Inflow, by *Frank Lane*, associate professor, engineering research, Ordnance Research Laboratory, Pennsylvania State College, State College, Pa.

(By Title)* **A Progressing Wave Approach to the Theory of Blast Shock,** by *R. G. Newton*, department of physics, Harvard University, Cambridge, Mass.

1:30 p.m.

Session III

Large Deflections of Circular Plates, by *Marvin Stippes*, associate professor of applied mechanics,

* Not presented orally; preprint available at preprint desk.

DISCUSSING PLANS FOR THE APPLIED MECHANICS MEETING AT THE PENN STATE COLLEGE, JUNE 19–21, 1952

(Seated, *left to right:* O. B. Schier, II, ASME meetings manager; R. L. Stanley, general chairman, local committee; R. E. Peterson, chairman, Applied Mechanics Division; S. Levy, chairman, Symposium on Shock and Vibration Instrumentation. Standing, *left to right*, local committee: B. H. Garcia, Jr., C. C. Dillio, J. C. Lester, J. A. Sauer, J. Marin, and R. K. Vierck.)

Washington University, St. Louis, Mo., and *A. H. Haunrath*, department of theoretical and applied mechanics, University of Illinois, Urbana, Ill.

Bending of Elastoplastic Circular Plates With Large Deflection, by *P. M. Naghdi*, assistant professor of engineering mechanics, University of Michigan, Ann Arbor, Mich.

Vibrations of Elastic Shells in a Fluid Medium and the Associated Radiation of Sound, by *M. C. Junger*, research fellow, acoustics, Cruft Laboratory, Harvard University, Cambridge, Mass.

Bending and Buckling of an Elastically Restrained Circular Plate, by *Herbert Reismann*, senior structures engineer, Consolidated Vultee Aircraft Corp., Fort Worth, Texas

(By Title)* **Large-Deflection Theory for Orthotropic Rectangular Plates Subjected to Edge Compression,** by *Syed Yusuf*, stress analyst, The Bristol Aeroplane Co., Ltd., Bristol, England

(By Title)* **The Marcus Method Applied to the Solution of the Uniformly Loaded Clamped Rectangular Plate Subjected to Forces in Its Plane,** by *C. C. Chang*, department of mechanics, and *H. D. Conway*, professor of engineering mechanics, Cornell University, Ithaca, N. Y.

(By Title)* **Bending of a Uniformly Loaded Rectangular Plate With Two Adjacent Edges Clamped and the Others Either Simply Supported or Free,** by *M. K. Huang*, assistant professor of mechanics, Rensselaer Polytechnic Institute, Troy, N. Y., and *H. D. Conway*, professor, engineering mechanics, Cornell University, Ithaca, N. Y.

1:30 p.m.

Session IV

The Concept of Complex Damping, by *N. O. Myklestad*, professor of theoretical and applied mechanics, University of Illinois, Urbana, Ill.

A Nonlinear Problem in the Bending Vibration of a Rotating Beam, by *Hsu Lo*, associate professor of aeronautical engineering, Purdue University, West Lafayette, Ind.

Free Oscillation of the Centrifugal Pendulum With Wide Angles, by *F. R. E. Crossley*, assistant professor of mechanical engineering, Yale University, New Haven, Conn.

Topics in Gyroscope Motion, by *Hillel Poritsky*, General Engineering Laboratory, General Electric Company, Schenectady, N. Y.

(By Title)* **Bending Vibrations of a Pipe Line Containing Flowing Fluid,** by *G. W. Housner*, California Institute of Technology, Pasadena, Calif.

7:00 p.m.

Banquet

Presiding: *R. E. Paterson*, chairman, Applied Mechanics Division

Speaker: *C. C. Furnas*, director, Cornell Aeronautical Laboratory, Inc., Buffalo, N. Y.

Subject: **Future Trends in Aviation**

FRIDAY, JUNE 20

9:00 a.m.

Session V

Symposium on Shock and Vibration Instrumentation—I

Introduction to the History of Vibration and Shock-Measuring Instruments, by *S. J. Zand*, vice-president in charge of engineering, and *G. W. Painter*, Lord Manufacturing Company, Erie, Pa.

The Single-Degree-of-Freedom System in Motion Measurement, by *Robert Rosenbaum*, chief, dynamics section, Civil Aeronautics Administration, Washington, D. C.

Secondary Effects in Seismic System Instruments, by *C. E. White*, chief engineer, Statham Laboratories, Los Angeles, Calif.

Vibration Pickup Calibrators, by *R. C. Lewis*, partner, The Calidyne Company, Winchester, Mass.

Significance of Mechanical Shock Measurements by Peak-Reading Instruments, by *Irwin Vigness*, head, shock and vibration branch, Naval Research Laboratory, Washington, D. C.

1:30 p.m.

Session VI

Symposium on Shock and Vibration Instrumentation—II

Instruments for Measuring and Recording Shock-Wave Pressures and Responses of Structural Members, by *H. E. Lewander*, manager, proving-ground department, Sandia Corporation, Albuquerque, N. Mex.

Shock and Vibration Instrumentation for Ships, by *R. T. McGoldrick*, head, Vibrations Division, David Taylor Model Basin, Washington, D. C.

Some Comments on the Dynamic Testing of Aircraft in Flight, by *L. S. Wasserman*, chief, aerodynamics group, Wright Air Development Center, Dayton, Ohio

Discussion Period

Moderator: Jesse Ormondroyd, professor of engineering mechanics, University of Michigan, Ann Arbor, Mich.

Panel: Authors of Symposium papers

5:00 p.m.

Inspection Trip

Thomas Water Tunnel, The Pennsylvania State College

7:00 p.m.

Informal "Get-Together"

Centre Hills Country Club

SATURDAY, JUNE 21

9:30 a.m.

Session VII

Forced Lateral Vibration of Beam Carrying a Concentrated Mass, by *W. H. Hoppmann, 2nd*, associate professor of mechanical engineering, The Johns Hopkins University, Baltimore, Md.

Plastic Rigid Analysis of Long Beams Under Transverse-Impact Loading, by *Margaret F. Conroy*, research assistant, Graduate Division of Applied Mathematics, Brown University, Providence, R. I.

Large Plastic Deformations of Beams Under Transverse Impact, by *E. H. Lee*, professor of applied mathematics, and *P. S. Symonds*, associate professor of engineering, Brown University, Providence, R. I.

Free Vibrations of Constrained Beams, by *W. F. Z. Lee*, teaching assistant, mechanical-engineering department, and *Edward Saibel*, professor, mechanics, Carnegie Institute of Technology, Pittsburgh, Pa.

(By Title)* **The Wave Method for Solving Flexural-Vibration Problems,** by *R. P. N. Jones*, post-graduate school of applied mechanics, University of Sheffield, Sheffield, England

9:30 a.m.

Session VIII

Correlation of Creep Properties by a Diffusion Analogy, by *Leon Green, Jr.*, development engineer, Aerojet Engineering Corp., Azusa, Calif.

Deflection and Stresses in Beams Subjected to Bending and Creep, by *Yoh-Han Pao*, research associate, and *Joseph Marin*, professor of engineering mechanics, The Pennsylvania State College, State College, Pa.

Bending With Axial Force of Curved Bars in Plasticity, by *Aris Phillips*, assistant professor, Timoshenko Laboratory, Stanford University, Stanford, Calif.

(By Title)* **The Limit Design of a Transversely Loaded Square Grid,** by *Jacques Heyman*, formerly research associate, Graduate Division of Applied Mathematics, Brown University, Providence, R. I.

1:30 p.m.

Session IX

Plastic Flow in a V-Notched Bar Pulled in Tension, by *E. H. Lee*, professor of applied mathematics, Brown University, Providence, R. I.

A Simple Method of Determining Plastic Stresses and Strains in Rotating Disks With Nonuniform Metal Properties, by *M. H. Lee Wu*, formerly aeronautical research scientist, Lewis Flight Propulsion Laboratory, NACA, Cleveland, Ohio

Determination of Theoretical Plastic Stress-Strain Relations for Variable Combined Stress Ratios, by *L. W. Hu*, research associate, department of engineering mechanics, and *Joseph Marin*, professor of engineering mechanics, The Pennsylvania State College, State College, Pa.

(By Title)* **Experiments on the Plastic Compression of a Block Between Rough Plates,** by *J. F. Nye*, formerly with Cavendish Laboratory, Cambridge, England, and now with Bell Telephone Laboratories, Murray Hill, N. J.

(By Title)* **A Theory of Plastic Bending From a Statistical Aspect,** by *Ing. Habil H. Cramer*, Alexandria, Egypt

1:30 p.m.

Session X

The Plane-Stress Problem of Perforated Plates, by *Gabriel Horvay*, development engineer, Knolls Atomic Power Laboratory, General Electric Company, Schenectady, N. Y.

Thermal Stresses in Bodies Exhibiting Temperature-Dependent Elastic Properties, by *H. H. Hilton*, assistant professor of aeronautical engineering, University of Illinois, Urbana, Ill.

Temperature Development in a Heated Contact, With Application to Sliding Contacts, by *Ragnar Holm*, Stackpole Carbon Company, St. Marys, Pa.

ASME Oil and Gas Power Division to Meet in Buffalo, N. Y.

24th Conference Headquarters—Statler Hotel

THE 24th annual conference and exhibit of the Oil and Gas Power Division of The American Society of Mechanical Engineers will be held in the Statler Hotel, Buffalo, N. Y., June 23–27, 1952.

A program of technical papers and discussions of unusual interest has been prepared, and all who are interested in the design, operation, and maintenance of Diesel, dual-fuel, and gas engines are invited to attend and participate in this conference.

The program is arranged to allow liberal time for inspection of a number of interesting plants in Buffalo and vicinity, including the Worthington Corporation, Niagara Hydro plant, Van der Horst Corporation, and Clark Brothers Company, Inc., at Olean, and others. A large number of manufacturers of engines, accessories, plant equipment, and services will be represented in the exhibit.

Subjects for the technical sessions will include papers on engine lubrication, spark-ignition gas engines, crankshaft design problems, and Diesel-engine power plants. The latter session embraces three subjects—Diesel versus steam-power plants, the place of Diesel engines in the REA program, and vapor-phase cooling. Also featured on the program is a panel discussion on engines of high specific output, subdivided under design improvements in high-output Diesel engines from both the Navy and industrial viewpoints; valves; pistons, piston inserts, and piston rings; and a special view of the piston sealing problem. All subjects will be handled by engineers of high standing in the industry and the entire conference is planned to be helpful to all who are concerned with internal-combustion power equipment.

Women's Program

The welcome luncheon and a "get-acquainted" tea are the events scheduled to open the women's program. The Oneida Silver Company of Canada, manufacturers of Community Plate, will conduct an inspection trip

of the plant, after which the men will join the group for a sight-seeing trip of Niagara Falls. There will be time to visit the English china shops before dining in the Blue Room of the General Brock Hotel. From this room there is an excellent view of the Falls, which will be illuminated after dark. Early morning risers on Wednesday are invited to be guests of the audience-participation radio program, "Breakfast at the Lenox." A tour of the Kittinger Furniture Company will follow. This company is the only builder of Williamsburg reproductions. A bridge-luncheon at the newly completed Yacht Club, situated on Buffalo's beautiful water front, will precede the banquet in the evening, to which the women are invited. Thursday's schedule will feature a guided tour of the Albright Art Gallery. After luncheon in the club room of the art gallery there will be time for shopping at Sattler's Department Store. Closing the activities is an invitation for the women to accompany the men on the trip to Olean, N. Y., where the local ASME ladies will entertain at luncheon.

The Hotel Statler, Buffalo, N. Y., has set aside a large block of rooms for this conference. It is important, when requesting reservations, to mention the ASME Oil and Gas Power Conference to insure prompt attention.

The tentative technical program follows:

MONDAY, JUNE 23

8:30 a.m.

Registration

10:30 a.m.

Technical Session

Crankshafts and Related Subjects

Investigation on Hydrogen Foam From the Shrunken Part of Web and Journal of Diesel-Engine Crankshafts, by *M. Iwo*, Yokosuka, Japan.

Dynamic Shear-Modulus Apparatus and Production Test Results for a Cast Crankshaft Alloy, by *J. D. Swannack and R. J. Maddock*, design analysis section, engineering department, Fairbanks, Morse and Co., Beloit, Wis.

Torsional Vibration of Engine-Shaft System With Flexible Coupling Having Nonlinear Elasticity, by *F. P. Porter*, American Locomotive Co., Schenectady, N. Y.

12:30 p.m.

Welcome Luncheon

Presiding: R. G. Tessmer, chairman, Buffalo Section, ASME

Address by: C. C. Fichtner, executive vice-president, Buffalo Chamber of Commerce

Speaker: R. J. S. Pigott, President, ASME; director of engineering, Gulf Research and Development Co., Pittsburgh, Pa.

2:p.m.

Technical Session

Engine Lubrication

Lubrication Problems in Design of Heavy-Duty Engines, by *W. J. Blessing*, chief engineer, Engine Division, Worthington Corp., Buffalo, N. Y.

Some Considerations in Bearing Operation, by *R. J. S. Pigott*, director of engineering, Gulf Research and Development Co., Pittsburgh, Pa.

8:00 p.m.

General Technical Committee Meeting

Panel Members:

Engines: J. J. Ehrat, Baldwin-Lima-Hamilton Corp., Hamilton, Ohio; *D. J. Cummins*, vice-president, Cummins Engine Co., Columbus, Ind.

Piston Rings: R. W. Hoyt, vice-president and chief engineer, Double Seal Ring Co., Fort Worth, Texas

Bearings: C. O. Donley, chief engineer, Allison Division, General Motors Corp., Indianapolis, Ind.

Oils: R. W. Van Sant, chief fuels and lubricants engineer, Gulf Oil Corp., Pittsburgh, Pa.

Air Filters: W. K. Gregory, president, Continental Air Filters, Inc., Louisville, Ky.

TUESDAY, JUNE 24

9:30 a.m.

OGP Special Lecture

Heat Transmission in Internal-Combustion Engines, by *C. F. Taylor*, Massachusetts Institute of Technology, Cambridge, Mass.

2:00 p.m.

Inspection Trip

Tour of Schoellkopf Hydroelectric Plant followed by a dinner at the General Brock Hotel overlooking Niagara Falls, Ont., Can.

WEDNESDAY, JUNE 25

9:30 a.m.

Technical Session

Spark-Ignition Gas Engines

Combustion Fundamentals of Heavy-Duty Gas Engines, by *W. K. Newcomb*, engineering consultant, Ingersoll-Rand Co., Painted Post, N. Y.

Recent Trends in High-Compression Gas Engines, by *W. M. Kaufmann*, research and development engineer, Worthington Corp., Buffalo, N. Y.

Electrical Ignition of High-Compression Engines, by *S. E. Miller*, vice-president, engineering, American Bosch Corp., Springfield, Mass.

2:00 p.m.

Panel Discussion

Engines of High Specific Output

Design Improvements in High-Output Diesel Engines—Navy Viewpoint, by *R. A. Coulombe*, Bureau of Ships, Navy Department, Washington, D. C.

Design Improvements in High-Output Engines—Industrial Viewpoint, by *D. Bohn*, Aluminum Company of America, Cleveland, Ohio

Valves for High-Output Engines, by *John Newton* and *Cliff Allen*, Thompson Products Co., Cleveland, Ohio

Pistons and Piston Rings for High-Output Engines, by *J. W. Pennington*, chief engineer, piston-ring department, Koppers Co., Inc., Baltimore, Md.

7:00 p.m.

Banquet

Presiding: H. W. Whiting, chairman, Arrangements Committee; Worthington Corp., Buffalo, N. Y.

Toastmaster: E. J. Schwanhouser, Worthington Corp., Harrison, N. J.

Speaker: Rob Roy MacLeod, commercial manager, Niagara Mohawk Power Corp., Buffalo, N. Y.

Subject: The American Package

THURSDAY, JUNE 26

9:30 a.m.

Technical Session

Diesel-Engine Power Plants

Diesel Power Plants Versus Steam-Power Plants, by *G. V. Yarger*, superintendent, Municipal Utilities, Waverly, Iowa

The Place of the Diesel Engine in the REA Program, by *E. J. Rauschenberger*, chief, internal-combustion plant section, Rural Electrification Administration, Washington, D. C.

Engine Cooling at Elevated Temperatures With Vapor Phase, by *L. C. Harbert*, president, Engineering Controls, Inc., Los Angeles, Calif.

2:00 p.m.

Inspection Trip

Tour of the Worthington Corp. Plant, Buffalo, N. Y.

FRIDAY, JUNE 27

All-day inspection bus trip to the plants of Clark Brothers Co., Inc., Olean, N. Y., and the Van der Horst Corporation, Olean, N. Y.

West Coast Applied Mechanics Meeting Plans Announced

THE West Coast Meeting to be sponsored by the Applied Mechanics Division of The American Society of Mechanical Engineers will be held at the University of California, Los Angeles, Calif., June 26–28, 1952.

Morning and afternoon sessions are scheduled for each day. There will be a symposium on earthquake and blast effects on structures, June 26–28. Also scheduled are laboratory inspection trips.

A joint Heat Transfer and Fluid Mechanics Institute and the Earthquake and Blast Symposium dinner has been arranged for June 26 at 6:30 p.m. at Kerckhoff Hall on the campus.

The tentative technical program follows:

THURSDAY, JUNE 26

8:30 a.m.

Registration

9:30 a.m.

First Session

A Matrix Method For Flexibility Analysis of Piping Systems, by *J. E. Brock*, Midwest Piping and Supply Co., St. Louis, Mo.

A Comprehensive Stability Criterion for the Forced Vibrations in Nonlinear Systems, by *K. Klotter*, Stanford University, and *E. Pinney*, University of California, Berkeley, Calif.

Rails on Elastic Foundation Under the Influence of High-Speed Traveling Loads, by *H. E. Criner* and *G. D. McCann*, California Institute of Technology, Pasadena, Calif.

2:00 p.m.

Second Session

Critical Whirling Speeds of Shaft-Disk Systems, by *N. H. Jasper*, David Taylor Model Basin, Washington, D. C.

A Mathematical Analysis of the Relaxation Type of Vehicle Suspension, by *J. Gallagher*, Douglas Aircraft Co., El Segundo, Calif., and *E. Volterra*, Illinois Institute of Technology, Chicago, Ill.

The Characteristics of Fluid Motion Which Affect Airplane Dynamics, by *E. W. Graham* and *A. M. Rodrigues*, Douglas Aircraft Co., Santa Monica, Calif.

Calibration of Pressure Gages for Work in Ballistics, by *S. Raiser*, Armour Research Foundation, Chicago, Ill.

FRIDAY, JUNE 27

9:30 a.m.

Third Session

Combined Tension-Torsion Tests for Aluminum Alloy 2S-O, by *A. Phillips*, Stanford University, Stanford, Calif.

On Longitudinal Plane Waves of Elastic-Plastic Strain in Solids, by *D. S. Wood*, California Institute of Technology, Pasadena, Calif.

Effect of Surface Condition on Creep of Some Commercial Metals, by *E. D. Sweetland*, consulting engineer, San Francisco, Calif., and *E. R. Parker*, University of California, Berkeley, Calif.

2:30 p.m.

Fourth Session

Thin Rectangular Plates on Elastic Foundation, by *H. J. Fletcher* and *C. J. Thorne*, University of Utah, Salt Lake City, Utah

Stability of Thin Elastic Plates Covering an Arbitrary Simply-Connected Region and Subject to Any Admissible Boundary Condition, by *G. Zissicas*, University of California, Los Angeles, Calif.

Limit Design of a Full Reinforcement for a Circular Cutout in a Uniform Slab, by *H. J. Weiss* and *W. Prager*, Brown University, Providence, R. I., and *P. G. Hodge, Jr.*, University of California, Los Angeles, Calif.

Stress Singularities Resulting From Various Boundary Conditions in Angular Corners of

Plates in Extension, by *M. L. Williams*, California Institute of Technology, Pasadena, Calif.

SATURDAY, JUNE 28

9:30 a.m.

Fifth Session

Minimum Weight of Tapered Round Thin-Wall Columns, by *M. Feigen*, University of California, Los Angeles, Calif.

The Stresses in a Flat Curved Bar Due to Concentrated Radial Loads, by *C. W. Nelson, C. J. Ancker, Jr.*, and *N. G. Wu*, University of California, Berkeley, Calif.

Gravitational Stresses on Deep Tunnels, by *Y. Yu*, Washington University, St. Louis, Mo.

1952 Heat Transfer and Fluid Mechanics Institute Program Announced

THE fifth annual meeting of the Heat Transfer and Fluid Mechanics Institute will be held June 24–26, 1952, in Room 147, Business Administration and Economics Building at the University of California, Los Angeles, Calif.

The Institute is sponsored by the following universities: California Institute of Technology, University of California (Berkeley and Los Angeles), Stanford University, University of Southern California, and Santa Clara University. The Institute was also sponsored by the following engineering societies: The American Society of Mechanical Engineers, the Institute of the Aeronautical Sciences, and the northern and southern California Sections of the American Institute of Chemical Engineers. The general chairman of the Institute is L. M. K. Boelter, Fellow ASME, dean, college of engineering, University of California, Los Angeles, Calif., and E. K. Springer, Mem. ASME, vice-chairman. Vito A. Vanoni is chairman of the Papers and Program Committee, and N. Van de Verg and Robert Bromberg, Jun. ASME, co-chairmen.

All papers were reviewed by personnel at the sponsoring universities and also by engineers in industry engaged in related work.

The tentative program follows:

TUESDAY, JUNE 24

8:00 a.m.

Registration

9:30 a.m.

Session I

Chairman: F. E. Marble, California Institute of Technology and Jet Propulsion Laboratory

Address of Welcome: L. M. K. Boelter, general chairman, 1952 Heat Transfer and Fluid Mechanics Institute

Heat Transfer to Molten Lead-Bismuth Eutectic in Turbulent Pipe Flow, by *H. A. Johnson*, Mem. ASME, *J. P. Hartnett, W. J. Clabaugh*, University of California, Berkeley, Calif.

Skin Friction and Heat Transfer Through Turbulent Boundary Layers for Incompressible and Compressible Flows, by *C. D. Donaldson*, National Advisory Committee for Aeronautics, Langley Field, Va.

1:30 p.m.

Session II

Stability of Gas Flow in a Tube as Related to Vertical Annular Gas-Liquid Flow, by *A. D. K. Laird*, University of California, Berkeley, Calif.

The Growth or Collapse of a Spherical Bubble in a Viscous Compressible Liquid, by *F. R. Gilmore*, California Institute of Technology, Pasadena, Calif.

WEDNESDAY, JUNE 25

9:30 a.m.

Session III

Chairman: F. E. Romie, Jun. ASME, University of California, Los Angeles, Calif.

Boundary-Layer Transition in Supersonic Flow, by *Carl Gazley, Jr.*, General Electric Company, Schenectady, N. Y.

Experimental Investigation of the Local and Average Skin Friction in the Laminar Boundary Layer on a Flat Plate at a Mach Number of 2.4, by *R. C. Maydew* and *C. C. Pappas*, National Advisory Committee for Aeronautics, Moffett Field, Calif.

1:30 p.m.

Session IV

The Application of an Electromagnetic Analogy to the Determination of Induced Camber Correction for Wide-Bladed Propellers, by *B. W. McCormick, Jr.*, The Pennsylvania State College, State College, Pa.

Effects of Impurities on the Supersaturation of Nitrogen in a Hypersonic Nozzle, by *P. D. Arthur* and *H. T. Nagamatsu*, California Institute of Technology, Pasadena, Calif.

THURSDAY, JUNE 26

9:30 a.m.

Session V

Chairman: R. A. Seban, University of California, Berkeley

Anemometry of a Heated Flat Plate, by *T. Y. Wu* and *J. D. Cole*, California Institute of Technology, Pasadena, Calif.

Laminar-Flow Forced Convection in Long Rectangular Tubes, by *S. H. Clark* and *W. M. Kays*, Stanford University, Stanford, Calif.

Temperature Distribution in the Walls of Heat Exchangers With Noncircular Flow Passages, by *E. R. G. Eckert*, University of Minnesota, Minneapolis, Minn.

2:00 p.m.

Session VI

Tour of the department of engineering facilities, University of California, Los Angeles, Calif.

Coming Meetings

C.I.G.R.É. Conference

The U. S. National Committee of Conference Internationale Grands Réseaux Électriques (International Conference on Large Electric High-Tension Systems) plans to participate in the 14th biennial session of C.I.G.R.É. which is to be held in Paris from May 28 to June 7, 1952.

These conferences are attended by 1500 delegates from 40 different countries and are devoted to discussions of all problems relating to the generation, transmission, and distribution of electric power. They are of particular interest to executives and design and operating engineers in both the electric-power and electric-manufacturing industries.

Of 120 technical papers to be presented at the June conference, 13 will be of United States authorship.

There are 1650 permanent members of C.I.G.R.É. in 45 different countries and there are 230 individual permanent members and 18 collective permanent members in the United States. These U. S. individual memberships comprise executives and engineers from power-utility companies, power agencies, and electrical-manufacturing companies; the U. S. collective memberships comprise electrical associations and the principal electrical-manufacturing companies and consulting-engineering firms.

Philip Sporn, Fellow ASME, president, American Gas and Electric Service Corporation, New York, N. Y., will represent ASME at the conference. Arrangements have been made for a large and representative United States delegation to attend the conference.

Experimental Stress Analysis

THE spring meeting of the Society for Experimental Stress Analysis will be held at the Hotel Lincoln, Indianapolis, Ind., May 14–16, 1952, and will feature technical sessions and panel discussions covering such subjects as strain-gage techniques, testing methods, electrical strain-gage techniques, photoelasticity, analogies, brittle lacquers and brittle material methods, general problems of experimental stress analysis, columns, vibration analog, and strain-gage techniques with reference to residual stresses.

For further information write to W. V. Covert, chairman SESA Meetings Committee, of Diamond Chain Company, Inc., Indianapolis 7, Ind.

Refrigeration

THE American Society of Refrigerating Engineers Convention will be held at the Biltmore Hotel in Atlanta, Ga., June 1–4, 1952. An innovation in ASRE conventions will be an exhibit of research and laboratory equipment of interest to and used by domestic refrigerator engineers. This will be in no sense a commercial exhibit but will be of interest to design engineers. Among the exhibits being planned are a new low-cost polystyrene design for deep drawing with a vacuum process; a new-finish porcelain not requiring a cobalt ground coat; demonstration of a new silicone finish that facilitates water run-off; demonstration of a method of observing motor-winding temperatures during continuous operation; and demonstration of new combination timer and defrost thermostat.

Three regular technical sessions will include papers on atomic radiation as it may affect the refrigeration industry; lubrication, selection, and evaluation of oils for refrigeration systems; fundamentals of refrigerant piping; properties of metals at very low temperatures; a discussion of pressure-volume-temperature properties of the Freen compounds; thermal-electric analog, a method of determining heat transfer electrically; a description of a new refrigerator cabinet heat-leak calorimeter; some design and construction problems encountered in the erection of tonnage oxygen plants; how safety provisions may prevent aceidents; and the latest methods employed in freezing poultry.

The subject of the domestic refrigerator-engineering conference will be automatic defrost-

ing, which is now being incorporated in the refrigerator designs of most of the leading refrigerator manufacturers. In addition, there will be a description of a new finish designed for facilitating water run-off, and a discussion of control methods used in automatic defrosting.

Canadian International Trade Fair

THE Canadian International Trade Fair, which will be held in Exhibition Park, Toronto, Ont., Can., June 2–13, 1952, is receiving strong backing by Canadian business and industry. With three months still to go, Canadian space bookings in every one of the 16 trade categories in which the Fair is divided, are well ahead of the total amount taken by Canadian exhibitors in either the 1950 or 1951 Trade Fair.

The most noticeable increase is in the section containing machinery and plant equipment. Here, Canadian manufacturers have 20,000 sq ft to show a diverse selection of machine tools and heavy and light machinery and equipment for almost every type of industry.

Eleven of the approximately 30 countries expected to exhibit have submitted formal space applications. Denmark, exhibiting milking machines and Diesel motors, is in the Fair for the first time. Germany also will exhibit in a major way for the first time, particularly in the machine-tool section.

Britain, continuing her drive to establish and maintain broad Canadian markets, plans to be one of the top exhibitors in almost every category. British machine tools are expected to be one of the major features, but this year machine-tool makers will be showing on an individual basis rather than as an association.

The Netherlands is returning to the Fair with another comprehensive display of Dutch goods. Other countries to be represented at the Fair are Australia, Pakistan, Scotland, Sweden, Switzerland, and the United States.

British Mechanical-Handling Exhibit

THE British mechanical-aids team which came to the United States in 1949 to study American methods of mechanical handling will discuss that visit at the third Mechanical Handling Convention and Exhibition in London, England, to be held at Olympia Hall, June 4–14, 1952.

"Greater output at lower costs" will be the theme of the display. Some 170 firms occupying 250,000 sq ft will show conveyers, elevators, hoists, stackers, cranes, mechanical loaders and shovels, fork-lift trucks, industrial trucks, coal-handling plants, overhead runways, aerial ropeways, grain-handling plants, freight-car tipplers, and auxiliary equipment.

Outstanding exhibits will include new giant fork-lift trucks with a lifting capacity of 5 tons, shown for the first time in Great Britain; a pneumatic grain-handling plant in operation; an automatic crate-packing machine on an entirely new principle; two full-sized car tipplers; and a fork truck on giant pneumatic tires. One large manufacturer will be showing his new industrial tractor with various attachments for handling different classes of goods and materials.

For the first time overseas visitors will be given a free advice service at the overseas reception bureau. Two independent consulting engineers, experienced in mechanical handling, will be available for this purpose if prospective visitors notify the organizers, Associated Iliffe Press, Dorset House, Stamford Street, London, S.E. 1., in advance.

American visitors will be interested in the technical papers to be read at the convention, sponsored, respectively, by various associations, such as the Mechanical Handling Engineers Association, the Institution of Production Engineers, and the Association of Crane Makers.

Industrial Research Conference

THE third Annual Conference on Industrial Research will be held at Columbia University, June 9–13, 1952. The conference, which is under the sponsorship of the Columbia Center for Studies of Research Administration, of which D. B. Hertz, Jun. ASME, is the director, has as its theme this year "The Design of Research Operations." An outstanding program of speakers on the design of research facilities, research projects, programs, design of experiments, and operations research has been arranged. Inquiries concerning the Conference should be addressed to Prof. D. B. Hertz, 409 Engineering Building, Columbia University, New York 27, N. Y.

Hydraulics Conference

TRANSPORTATION of Sediment has been chosen as the theme of the fifth Hydraulics Conference to be held at Iowa City, Iowa, June 9–11, 1952. This series of triennial conferences is sponsored by the Iowa Institute of Hydraulic Research of the State University of Iowa. Topics of the six half-day sessions will include problems of laboratory and field measurement; sedimentation in canals, rivers, estuaries, and harbors; and a tour of the Institute laboratories.

Education

Heat-Transmission Lectures

THE engineering departments of the University of Michigan are sponsoring a special series of lectures dealing with problems in heat transmission as part of the 1952 summer session from June 27–August 9. Each Friday and Saturday an authority will deliver a lecture on his subject of specialization. On Wednesdays speakers from the University will deliver talks. The Wednesday and Friday sessions are scheduled from 3:00 to 4:30 p.m.; Saturday, from 10:00 to 11:30 a.m. Among the visitors and University speakers are W. A. Rohsenow, Jun. ASME; Martin Summerfield, Jun. ASME; E. R. G. Eckert, Mem. ASME; D. L. Katz, Mem. ASME; and Myron Tribus, Jun. ASME.

Further details may be obtained by writing Prof. W. W. Hagerty, Department of Engineering Mechanics, University of Michigan, Ann Arbor, Mich.

ASTE Launches Student-Aid Plan

IN recognition of the rapidly growing shortage of engineers in the United States, the American Society of Tool Engineers' program, providing financial aid to students in engineering schools, has been further extended by enlisting the financial assistance of industrial companies in areas where ASTE chapters are located.

The program is under way in several cities including Boston, Mass., Detroit, Mich., Worcester, Mass., and New Haven, Conn., and operates by having the entire chapter proceeds of affiliate membership dues of participating companies in the technical society allocated to the providing of scholarships.

Financial assistance to students will be supplied within the chapter area in which the participating company is located and supplements the national scholarships awarded annually by ASTE.

Scholarship awards are being made to those deserving 3rd, 4th, and 5th-year engineering students taking one or more courses in industrial or tool-engineering subjects such as plant layout, machine and tool design, jig and fixture design, production methods, and the like, at accredited engineering schools.

Fellowships at Stevens Institute

TWO fellowships in mechanical engineering at Stevens Institute of Technology will be awarded to outstanding candidates for an advanced degree by the Celanese Corporation of America, 180 Madison Avenue, New York, N. Y., beginning with the school year 1952–1953.

One Celanese Fellowship is open to a recent graduate of any engineering college of recognized standing (other than Stevens). Preference will be given to applicants who received their undergraduate degrees in chemical engineering, textile engineering, or engineering physics. The other Celanese Fellowship is open to a graduate in mechanical engineering of any college of recognized standing, provided that he has had at least one year of industrial experience.

The Westinghouse Fellowship in Engineering is available for graduate study in chemical, electrical, and mechanical engineering, or in metallurgy.

A limited number of fellowships for work at the Experimental Towing Tank Laboratory are open each year to college graduates interested in the broader principles of hydrodynamic research as well as the techniques of model tests of ship and flying-boat hulls.

Some graduate assistantships are available in chemistry, chemical, electrical, industrial, or mechanical engineering, metallurgy, and physics.

Applications for the various fellowships and assistantships must be submitted to the Office of the Dean, Stevens Institute of Technology, Hoboken, N. J., by May 15, 1952.

Texas A&M Instrumentation Symposium

THE Agricultural and Mechanical College of Texas has scheduled its 1952 symposium on "Instrumentation for the Process Indus-

tries" for June 2-4, Memorial Student Center, at College Station, Texas. Held in co-operation with the many important industrial firms of the Southwest, the meeting is jointly sponsored by manufacturers of instrument and control equipment who provide extensive exhibits of an educational nature.

Now a national institution, the symposium, in its seventh year, has scheduled the mid-year date to permit full continuity, without conflict with the Instrument Society of America's national meeting each fall.

Designed to strike a balance between theory and practical experience, the program again will include subjects related to the measurement and control of process variables, with recognition of new developments and current trends of the industry. The course will be conducted as a seminar, with lectures leading into discussions of various phases of this growing science, making it of important value to instrument, process design, and operating engineers, and management executives.

The registration fee is $6. Full information, including a program announcement folder, may be obtained from Prof. P. G. Murdoch, chemical-engineering department, Texas A&M College, College Station, Texas.

Career-Opportunity Program

A UNIQUE "career-opportunity" program offering extensive vocational and educational counseling service to the nation's high-school students has been announced by Fenn College. This program will feature a series of specially prepared descriptive career folders designed to thoroughly familiarize high-school students with 30 important vocational fields, including mechanical, electrical, and structural engineering; and personnel and labor relations.

These folders have been more than a year in preparation and were prepared and edited by a group of outstanding educators and Cleveland business and industrial leaders. College officials view the folders as excellent guidance aids and urge high-school counselors to make use of them whether the student has interest in Fenn or not, or is not planning to attend college.

Individual kits can be obtained by writing to Fenn College, Admission Office, Cleveland 15, Ohio.

M.I.T. Offers Special Courses

NEW developments in five phases of mechanical engineering will be emphasized in special courses in metal cutting, internal-combustion engines, lubrication engineering, vibration, and industrial photoelasticity to be given at M. I. T. during the summer of 1952. Other courses planned are: Digital computers and their applications; special functions; vibrations; and theory and applications of dielectric materials.

Because enrollment in these special courses will definitely be limited, early registration is advisable. Letters of application, including appropriate details regarding background and experience, and requests for further information should be sent to Prof. Ernest H. Huntress, Director of the Summer Session, Room 3-107, Massachusetts Institute of Technology, Cambridge 39, Mass.

University of Washington Research Fellowships

THE Engineering Experiment Station of the University of Washington, Seattle, Wash., announces the availability of research fellowships for 1952–1953. Research opportunities are offered in engineering, forest products, and geology. Assignments are open in connection with industry, government, and Engineering Experiment Station research projects. Teaching assistantships are also open.

Additional information and application forms may be obtained by writing the Director of the Engineering Experiment Station, University of Washington, Seattle 5, Wash. Applications may be submitted at any time.

Statistical Quality Control

IN RESPONSE to the growing demand, the College of Engineering at the University of Colorado will conduct its third annual training course in Statistical Quality Control during the period of June 17 to 27. The course will include the quality-control charts, acceptance sampling, and other industrial statistical methods. The continued high quantity and quality demanded in defense and consumer goods makes the control of manufactured products a vital management concern. Men of national reputation in these fields will serve as instructors. Applications for admission into or inquiry for further information about the course may be obtained by writing to J. F. Wagner, College of Engineering, University of Colorado, Boulder, Colo.

ERDL Trains Administrators

AN administrative training program, recently offered to 200 chiefs and administrative assistants of the Engineer Research and Development Laboratories, Fort Belvoir, Virginia, was a huge success.

The first of its kind to be given at the Fort Belvoir Laboratories in recent years, the program included a series of lectures on basic administrative topics, including training, relations, management, and standards.

Since the Engineer Research and Development Laboratories deal with representatives of private engineering concerns and other government agencies daily, co-operation between both parties in attempting to solve problems of technical data was stressed.

Guest speakers, including many top men in private and government agencies, pointed out ways in which they solved administrative problems.

Because of the success of the recent program, ERDL is now planning to offer a second-level supervisory program of eight lessons to line supervisors. This program will be carried out on the same basis as the previous course and include the same four topics in addition to safety, personnel administration, supervisory tools, and introduction to supervision.

G-E Education Plan Under Way

A NEW educational experiment, designed to help alleviate from a long-range standpoint the critical shortage of engineers, got under way in Schenectady, N. Y., at an educational conference between some 400 Capitol District high-school students, their counselors, and a group of selected General Electric Company engineers.

Planned through joint efforts of professional engineers, high-school guidance personnel, and industries in the area, the conference was said to be the first of its kind and was aimed at exposing high-school students to engineering and its possibilities as a vocation.

Educators and engineering groups felt that a deliberate personal exposure of students to engineering, not via booklets and pamphlets but through direct informal meetings conducted on a local scale, might prove successful.

High light of the conference came after two short talks when a panel of five selected students began firing a barrage of prepared questions at a second panel of eight G-E engineers, each representing a different field in the company. In addition to various kinds of engineering, the G-E panel represented patent, labor relations, purchasing, and sales fields.

According to the G-E panel, all industries are bidding at a high competitive level for engineers; an engineering education is of great value in almost any type of vocation; industry looks to graduates who have had analytical training; and engineering normally offers great satisfaction to a person, since he can actually witness the results of his work.

20 Colleges Participate in Columbia Plan

SIX MORE liberal-arts colleges have joined with the Columbia University school of engineering in a combined plan providing students with a five-year course of study leading to both the BA and engineering degrees.

The announcement by J. R. Dunning, Mem. ASME, dean of the school of engineering, pointed out that the inclusion of these colleges brings the total number of liberal-arts schools participating in the plan to 20.

The recent additions to the combined program are Alfred University, Alfred, N. Y.; Bethany College, Bethany, W. Va.; Centre College of Kentucky, Danville, Ky.; Albion College, Albion, Mich.; De Pauw University, Greencastle, Ind.; and Beloit College, Beloit, Wis.

Under the plan, students follow a liberal arts program for three years at the liberal-arts school and a subsequent two-year engineering program at Columbia. Appropriate bachelor's degrees are awarded by both institutions at the end of the five years. Without the plan, six years would normally be required to earn the two degrees.

The co-operative program whereby the Columbia Engineering School accepts students of senior standing in liberal-arts colleges other than those of Columbia University was announced in the spring of 1951. It represents an extension of a plan inaugurated in 1914 by the School of Engineering and Columbia College, the University's undergraduate college for men.

Literature

Diamond Tool Industry—1951

A SMALL brochure summarizing articles and patents that have been published during 1951 and which have a special bearing on the development of industrial diamonds, is available, free of charge, from the Industrial Diamond Information Bureau, 32-34 Hoborn Viaduct, London, E.C. 1., England.

Column Research

COLUMN Research Council of Engineering Foundation, Bulletin No. 1, "A Survey of Progress: 1944-1951," by B. G. Johnston, et al., is now available. Requests should be directed to L. S. Beedle, secretary, C. R. O. Fritz Engineering Laboratory, Lehigh University, Bethlehem, Pa.

Surface Roughness

AN American Standard, Physical Specimens of Surface Roughness and Lay, B46.2-1952, cosponsored by the Society of Automotive Engineers and The American Society of Mechanical Engineers, was recently published by ASME. The standard, a seven-page pamphlet, gives precision reference specimens, roughness comparison specimens, and a table. It may be purchased from ASME Order Department, 29 West 39th Street, New York 18, N. Y., at $1 a copy.

1952 ASHVE Guide

THE 1952 edition of The Heating, Ventilating, and Air-Conditioning Guide, published annually by The American Society of Heating and Ventilating Engineers, has been issued. The 30th edition has a total of 1520 pages and represents an increase in both usefulness and size. Thirty-two pages of new data have been added to the 1064-page Technical Data Section which contains technical and design information on 50 subjects.

The entire volume has been reviewed carefully and important revisions have been made throughout. The chapter arrangement of the last two editions has been retained, chapters being grouped under the familiar section titles: Fundamentals, human reactions, heating and cooling loads, combustion and consumption of fuels, systems and equipment, special systems, instruments and codes.

Copies of the guide, priced at $7.50, are available through ASHVE headquarters, 62 Worth Street, New York 13, N. Y.

Displacement Meters Code

THE American Petroleum Institute announced the publication of a revision of its "Tentative Code Covering Installation, Proving, and Operation of Positive-Displacement Meters in Liquid Hydrocarbon Service," first issued in July, 1946, and identified as API Code No. 1101. The 1946 issue and the current revision are the work of the Subcommittee for Joint ASME-API Volumeter Research of which L. S. Wrightsman, Humble Pipe Line Company, Houston, Texas, is chairman.

The code covers metering in pipe-line service, on tank trucks, and at loading racks and bulk plants. In addition, the new edition contains sections on meters in liquefied-petroleum gas products service and in oil-well production service. The Code is well illustrated with charts and diagrams.

The revision is the product of more than ten years' work by the joint ASME-API Committee. More than five years were spent in preparing the 1946 edition and since 1946 the committee has given careful study to all suggestions which have been offered for improvement. The revision is believed to represent a solution of most of the problems which have arisen from actual use of the Code. Copies may be obtained at $2 each from The American Petroleum Institute, 50 West 50th Street, New York 20, N. Y.

IES Lighting Handbook

PUBLICATION of the new Illuminating Engineering Society "Lighting Handbook," a 987-page, completely revised Second Edition, was recently announced.

The new IES Lighting Handbook contains 15 per cent more pages than the original 1947 edition, and the technical subject matter has been 75 per cent revised to incorporate into the new volume all of the newest developments in lighting techniques, application, and theory. The volume is completely illustrated, containing 657 photographs, detail sketches, and charts. Thoroughly cross-indexed for easy reference, the handbook's 24-page index contains more than 4500 reference items.

Copies may be obtained from IES, 1860 Broadway, New York 23, N. Y., price $8 a copy.

Industrial Atomic Energy

AS an aid to industry in participating in the Atomic Energy Program a new publication of the Atomic Energy Commission has now become available to the public. Entitled "The Role of Engineering in Nuclear Energy Development," this publication is a report of the proceedings of a symposium on nuclear engineering held at the Oak Ridge National Laboratory in September, 1951. This symposium was sponsored jointly by the Oak Ridge National Laboratory, the Oak Ridge Institute of Nuclear Studies, and the American Society for Engineering Education in a combined effort to accelerate the spreading of education in nuclear engineering throughout the nation's technical schools, so that U. S. industry may participate more fully in, and derive greater benefits from, the Atomic Energy Program. The papers contained in this report therefore "present enough declassified information in the field of nuclear engineering to help engineering educators more intelligently decide how best they can discharge their responsibility to the country's nuclear-energy effort."

TID 5031, "The Role of Engineering in Nuclear Energy Development," 509 pages including tables and photographs, sells for $1.40 a copy. Orders should be addressed to the Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C., accompanied by check or money order payable to the Treasurer of the United States.

Malleable-Iron Screwed Fittings

AN American Standard, Malleable-Iron Screwed Fittings, 150 Lb, B16.3—1951, cosponsored by Heating, Piping and Air-Conditioning Contractors, National Association of Manufacturers, Standardization Society of the Valve and Fittings Industry, and The American Society of Mechanical Engineers, was recently published by ASME. This 14-page book covers pressure ratings, sizes and method of designating openings of reducing fittings, marking minimum requirements for materials, dimensions and tolerances, and threading, and contains figures and eight tables. It may be purchased from ASME Order Department, 29 West 39th Street, New York 18, N. Y., for $1 a copy.

Turbine Lubricating Systems

THE 15-page booklet, "Recommended Practices for the Cleaning of Turbine Lubricating Systems," prepared by the Joint ASTM-ASME Committee on Turbine Lubrication, was recently published by The American Society of Mechanical Engineers. It contains the proposed recommended practices for the preparation of new turbine lubricating systems, the recommended practices for the cleaning of turbine lubricating systems after service, and recommended practice for the purification of turbine oils. A single copy costs $1, 20 per cent discount to ASME members, and may be purchased from ASME Order Department, 29 West 39th Street, New York 18, N. Y.

Oil and Gas-Engine Power Costs

THE Report on Oil and Gas Engine Power Cost for 1950 was recently published by The American Society of Mechanical Engineers in a 44-page book. The report includes 146 plants, an increase of 24 over the previous year. Once again operators of dual-fuel and gas-engine plants were invited to participate. Also included in the report are 28 plants with a total of 64 dual-fuel engines and two gas-engine plants with a total of six gas engines. There are four figures and an index of tables. This report may be obtained from ASME Order Department, 29 West 39th Street, New York 18, N. Y., and is priced at $2.50, 20 per cent discount to ASME members.

Steel-Castings Publications

THE Steel Founders' Society of America announces their list of current publications. Available without charge are: "The Steel Casting Industry," "General Engineering Types of Steel Castings (2-page chart)," "Fundamentals of Steel Casting Design," and "Developments Concerning the Properties of Cast Steels." "Recommended Practice for the Welding of Steel Castings," a 40-page pamphlet, costs 35 cents, and "Steel Casting Handbook," a 510-page book of national technical recognition, is priced at $4. These publica-

tions may be obtained from the Steel Founders' Society of America, 920 Midland Building, Cleveland 15, Ohio.

Engineering Index

INTERNATIONALLY known for its thorough coverage of all branches of engineering, "The Engineering Index," 1928–1949, has just been reprinted. These guide books record the developments in the various fields of engineering and include articles from engineering and industrial publications, transactions of engineering and allied societies, miscellaneous reports, as well as reviews of scientific and technical books.

The annotated reference items provide a comprehensive digest of vital information on technical, scientific, and economical problems assembled during 1928–1949. Important articles in the international engineering literature of these years have been abstracted and classified by a staff of qualified editors.

These volumes are no longer available in the original edition and were reprinted with the permission of the original publishers. The reprinted 1928–1932 volumes are priced at $300 for a cloth-bound set and at $70 for single, cloth-bound volumes. The 1933–1949 volumes are priced at $900 for a cloth-bound set, and at $60 for single, cloth-bound volumes. The reprint was undertaken by Johnson Reprint Corporation, 125 East 23rd Street, New York 10, N. Y.

Survey Shows Poor Communications Wastes Engineering Manpower

AN estimated 60 per cent of the potential managerial talent of engineers is being lost to industry today, due to poor communications between engineers and the top management of industry.

This was disclosed in a nation-wide survey of 350 industrial companies employing some 50,000 engineers. A 48-page report on the survey, the result of six months' research by the National Society of Professional Engineers, was released by L. L. Dresser, president of the professional society.

Copies of this report on communications may be obtained from the national headquarters of the society at 1121 15th Street, N. W., Washington 5, D. C.

Science Report

THE first annual report of the National Science Foundation, 1950–1951, was issued by A. T. Waterman, director. It is by necessity a report of progress in formulating plans for the Foundation, established by act of Congress on May 10, 1950. The report is for sale by the Superintendent of Documents, U. S. Printing Office, Washington 25, D. C., at 20 cents a copy.

Midwest Fluid Mechanics Conference

THE second Midwestern conference on fluid mechanics was held at The Ohio State University March 17–19, 1952. Approximately 275 registered for the three-day conference to hear and discuss the 48 technical papers presented. The Monday evening session was a joint meeting with the Columbus Section of ASME and was attended by 150 members and guests. The feature speaker of the evening was Prof. E. R. G. Eckert, Mem. ASME, who presented an illustrated paper on "Developments in Convective Heat-Transfer Research."

Cloth-bound proceedings of the conference are being published by the Ohio State Engineering Experiment Station and will be available in October, 1952. Prepublication subscriptions will be available until Aug. 1, 1952, at the reduced price of $5 a copy. Orders may be addressed to Prof. K. W. Cosens, department of civil engineering, Ohio State University, Columbus 10, Ohio. Checks payable to the Ohio State University should accompany orders.

Actions of the ASME Executive Committee

At a Meeting at Headquarters, March 20, 1952

A MEETING of the Executive Committee of the Council was held in the rooms of the Society on March 20, 1952. R. J. S. Pigott, chairman, presided. In addition to Mr. Pigott, there were present: H. R. Kessler, R. A. Sherman, W. F. Thompson of the Executive Committee; L. W. Houston (Finance Committee), E. J. Kates, assistant treasurer, E. G. Bailey, past-president, H. E. Martin, director at large, C. E. Davies, secretary, and Ernest Hartford, executive assistant secretary.

Lectureships Program

The ASME Lectureships program, under which the services of outstanding lecturers are made available to Sections, was revived on a trial basis during the first three months of 1952. At the request of the vice-presidents, the Board on Technology developed a broader lectureship program for 1952–1953. After consideration of the proposed program, the Executive Committee voted to authorize the lectureship program for 1952–1953 subject to provision of the funds by the Finance Committee.

PTC Committee No. 7

Upon recommendation of the Organization Committee, it was voted to change the name of PTC Committee No. 7 on Reciprocating Steam-Driven Displacement Pumps to PTC Committee No. 7 on Reciprocating Displacement Pumps.

Certificate of Award Policy

Upon recommendation of the vice-presidents, it was voted to change item (*d*) of the Policy for Certificate of Award to read: "Chairmen of Sections, within six months of their retirement, upon initiation of their committee associates and recommendation of the vice-presidents."

Applied Mechanics Reviews

The report of the Managing Committee on the status of *Applied Mechanics Reviews* was reviewed. It was voted to request the Managing Committee of *Applied Mechanics Reviews* to make a study of the future usefulness of the *Reviews* and to determine whether the magazine would be self-supporting in the near future. It was also voted to approve the budget for the *Reviews* for 1952.

Western Hemisphere Management Conference

Upon recommendation of the Management Division, the Council voted to invite the International Committee on Scientific Management to assume sponsorship of a Western Hemisphere Management Conference to be held during the Fall Meeting of the Society, in Chicago, during the Engineering Centennial. It was also voted to invite the National Management Council, U. S. A., the Canadian Management Council, and the Brazilian Management Council to participate.

National Management Council

The Secretary reported that the Management Division had appropriated $1000 to supplement the Society's contribution to the National Management Council. Appreciation was expressed to the Division for its contribution, which will be forwarded to the NMC with the Society contribution.

Calvin W. Rice Lecturer

The selection of Colonel L. Urwick, management consultant of England, as Calvin W. Rice Lecturer at the Fall Meeting in Chicago was approved.

Corpus Christi Subsection

The establishment of the Corpus Christi Subsection of the South Texas Section was approved.

Certificates of Award

Upon recommendation of the Board on Codes and Standard, Certificates of Award were granted to the following for outstanding leadership in the development of the Society's Power Test Codes: Louis Elliott and E. B. Ricketts.

Certificates of Award were approved for the following retiring chairmen of Sections: Delaware Section (first half of 1951–1952), Byron A. Lininger; (second half of 1951–1952), LeRoy A. Grettum.

Certificate of Award was approved for Huber O. Croft, retiring chairman of the Education Committee.

Upon recommendation of their respective vice-presidents, Certificates of Award were approved for the following:

Russell T. Vogdes, Jr., now serving as chairman of Junior Group, Philadelphia Section, 1951–1952.

R. H. Bacon, chairman, Chicago Section, 1928–1929.

W. H. Oldacre, chairman, Chicago Section, 1948–1949 (posthumously).

Lyle Borst, chairman, Minnesota Section, 1946–1947, and "for his outstanding work in directing the 1951 Fall Meeting of the Society."

Saturday Closing

Closing of the Secretary's office on Saturday was approved by the Council by letter ballot, to be confirmed at the June meeting of the Council.

Open House and Refurnishing Council Room

After discussion, the Committee approved the idea of holding an open house so that members of the Metropolitan Section (and other Sections during the Annual Meeting) could make an official visit to ASME Headquarters. However, it was agreed that such visits would have to wait until the Council Room was renovated and refurnished. After further discussion, the Committee voted to ask the Finance Committee to review the problem of refurnishing the Council Room and make recommendations at the next meeting.

Legacy for Old Guard Fund

It was reported that the sum of $250 had been bequeathed to the Old Guard Fund by William P. Caine, a member of the Old Guard, who died July 25, 1951.

Exploratory Group Report

Seventeen out of eighteen members of the Council approved by letter-ballot action the final report of the Exploratory Group on Unity of the Engineering Profession. The Secretary has notified Engineers Joint Council of the favorable result of the ballot.

ASTM Fiftieth Anniversary

It was reported that ASME has been invited to send a delegate to the fiftieth anniversary celebration of the American Society for Testing Materials in June, 1952. The Committee expressed its appreciation for the invitation and authorized the president to designate a representative to the celebration.

Harry M. Pflager

The death of Harry M. Pflager, Honorary Member ASME, on October 28, 1951, was reported.

Appointments

The following appointments on committees and joint activities were approved: Medals Committee (Board on Honors), Theodore H. Beard, Burnham Finney, R. D. Brizzolara, and Eugene Caldwell; Petroleum Division, C. R. Draughon; Production Engineering Division, Sampson M. Weckstein; Power Test Codes Committee No. 19 on Instruments and Apparatus, (Subcommittee C), S. R. Beitler, L. J. Hooper, Andre L. Jorissen; (executive committee) A. A. Berk; Power Test Codes Committee No. 23 on Atmospheric Water-Cooling Equipment, Michael W. Larinoff; American Safety Code for Logging and Sawmills, B13, Frank Alberti; and Engineers' Council for Professional Development, Education Committee, Region IV, Karl P. Hanson.

The following presidential appointment was confirmed: Justin J. McCarthy and Robert W. Worley, to annual meeting of American Academy of Political and Social Sciences.

Engineering Manpower Commission

T. A. Marshall, Jr., reported that the major effort of the Engineering Manpower Commission in the past three months had been concentrated on the UMT and Reserve Legislation now pending in Congress. Carey H. Brown, chairman, EMC, has appeared before the House Committee and has also submitted a statement on UMT to the Senate Committee. Draft of a proposed statement for use before the Senate Armed Services Committee with the Armed Forces Reserve Act of 1951 has been prepared.

Mr. Marshall also reported that thirty-thousand copies of a poster, developed for distribution to secondary schools throughout the country, have been mailed. (See page 419 of this issue of MECHANICAL ENGINEERING.)

He reported further that joint efforts of EMC and the Engineers' Council for Professional Development have resulted in an increase in freshman engineering enrollment for 1951 of 15.4 per cent over 1950, as compared with a decrease in all male college-freshmen enrollment of 12.3 per cent covering the same period.

Contributions of $81,925 from 116 companies to the 1952 EMC budget were reported.

Unity of the Engineering Profession

E. J. Kates reported on progress made since the Report of the Exploratory Group for Increased Unity of the Engineering Profession (see MECHANICAL ENGINEERING, March, 1952, pages 255–258) was submitted for statement of probable action to organizations represented in the Group. Mr. Kates reported on written communications received from these societies. Representatives of societies in the Exploratory Group present then made oral statements.

After discussion, EJC, in accordance with recommendations made by its executive committee, voted to ask the Committee on Constitution and By-Laws to submit for approval suitable changes in the Constitution. It was also voted to request H. S. Osborne, chairman, EJC Committee on Increased Unity of the Engineering Profession, to study the merits and disadvantages of membership on the Governing Board of the proposed expanded EJC being on an equal representation basis, or proportioned according to membership size of each constituent society.

Centennial of Engineering

In a report on the Convocation to be held at the Centennial of Engineering, E. L. Chandler stated that 12 symposium programs will be held. Also in connection with the Centennial, it was voted to send invitations to the Boards of the five constituent societies to hold a joint meeting in Chicago at that time.

Practice of Contracting Engineering Services

In connection with contracting of engineering services by industries holding defense contracts, Gail A. Hathaway gave a brief résumé of the many reports of violations of principles of the professional engineer and practices harmful to the profession. T. A. Marshall told of experiences of the Engineering Manpower Commission with this problem.

Engineers Joint Council Holds Meeting

THE Engineers Joint Council held its regular meeting in the Engineering Societies Building, New York, N. Y., on March 21, 1952. T. G. LeClair, president, EJC, presided.

"Who's Who in Engineering"

The following committee was appointed by the president to serve in connection with the new edition of "Who's Who in Engineering": A. A. Potter, chairman; G. W. Bailey, A. B. Bronwell, W. N. Carey, C. E. Davies, H. H. Henline, P. H. Robbins, E. H. Robie, S. L. Tyler, J. A. C. Warner, and L. E. Young.

International Relations

After a report by E. A. Pratt on plans for the UPADI Convention at New Orleans, it was voted to request constituent societies to recommend two delegates and an alternate for the EJC delegation to this convention. It was also announced that George Browne was appointed correspondent to the UPADI Bulletin, to be published quarterly in Montevideo, Uruguay, starting March, 1952.

Special Surveys Committee

H. H. Henline reported on a meeting of the Special Surveys Committee, held Feb. 26, to discuss the request of the National Scientific Register and the National Science Foundation for EJC assistance in maintaining a register of engineers. After agreeing with the earlier EJC decision that no comprehensive register was needed, the Committee proposed that the National Science Foundation set up an advisory body of outstanding engineers from industry, government, and engineering schools. This advisory group could help the Foundation secure a list of key representatives in the different engineering fields and geographical areas who could quickly supply names of men needed for emergency assignments. This proposal was unanimously adopted.

It was further reported that at its March 26 meeting, the Special Surveys Committee decided to make a survey of the numbers of engineering students available and the numbers registered in ROTC programs. A survey of the demand for engineering graduates in government and industry will also be made.

UNESCO Meeting

A brief report was made on the UNESCO Hunter College meeting and the recommendations resulting from it. (See MECHANICAL ENGINEERING, April, 1952, page 347, for Conclusions and Recommendations of Work Group 9.)

Contracts are now being awarded to firms without knowledge of whether or not they have adequate staffs to execute them. After discussion it was voted that a special task committee be appointed to draft an appropriate letter to the Director of Defense Mobilization for signature by President LeClair.

EMC Exhibits at Guidance Convention

THE Engineering Manpower Commission of the Engineers Joint Council, in cooperation with the Engineers' Council for Professional Development, displayed its exhibit and participated in the annual convention of the Council of Guidance and Personnel Associations, Inc., held in Los Angeles, Calif., March 31–April 3, 1952.

The EMC exhibit—one of more than 20 guidance exhibits—was made up of six large four-color posters and was viewed by approximately 1200 visitors. The EMC posters depicted the importance of the engineer and stressed the present shortage of this talent, pointing to such questions as what is an engineer, why do we need engineers, what secondary schools must do to better prepare talented youth, what curriculums must the undergraduates take, what must he have to succeed in the profession, and what are the existing opportunities in engineering.

Highlighting the many talks that were delivered throughout the convention was one on the increasing shortage of engineers, given by R. F. O'Mara, Mem. ASME, sales manager, Western Precipitation Corporation, Los Angeles. In his talk Mr. O'Mara pointed out that America cannot match any of her potential enemies man-for-man. He stated, "The United States must rely upon her industrial might and productive ability—and this means engineers must be properly utilized."

Engineers' Salaries

EVENING engineering students at The Cooper Union, New York, N. Y., all of whom are employed by day, are earning an average of nearly $4000 a year each—20 per cent more than the average earnings a year ago, according to a report by E. S. Burdell, president.

A survey of the students above the first year, just completed by Prof. H. F. Roemmele, Mem. ASME, dean of students, shows that the average evening student earns $3924 annually while attending classes. Last year the average of evening students was $3240—$684 less than today.

Mechanical-engineering students earn most ($4128 average) with electrical-engineering students next ($3864) followed by civil-engineering students ($3852) and chemical-engineering students ($3372). A year ago the average figures were $3492 for mechanicals, $3300 for civils, $3252 for chemicals, and $2976 for electricals.

Dr. Burdell attributed the high average earnings of the young men (there are no women this year although the school is co-educational) to the nation-wide shortage of technical workers.

The highest-salaried evening student is a plant superintendent (age 34) who earns $7500. A field engineer (age 27) and a chemical plant designer (age 25) each earn $7200 a year. Five other students earn more than $6000 a year each.

Keep in Touch

AS a result of letters received at headquarters on the subject of subscriptions involving change of address, which range in temper from the icy, specific, one-little-word-after-another to the downright irate variety, we thought it might help if we told you a little about the mailing procedure and what information we must have to change your address.

MECHANICAL ENGINEERING is delivered on a tight, fast schedule so that every subscriber—no matter where he lives in the United States—will receive his copy on the same day each month. The address labels are made up in strips in advance and sorted into geographic groups so that copies of the magazine destined for subscribers in a certain city or locality can be shipped all at once by the most direct means available.

To process an address change, it is necessary to make up a new address plate, from which the labels are printed. In addition the old plate must be located and replaced by the new one. From the time you mail your letter requesting a change until the entire process has been completed and a copy of MECHANICAL ENGINEERING arrives at your new address, it usually takes three to four weeks. So it is a good idea to give us as much advance warning as you can if you plan to move, and, of course, be sure to tell us the date on which you want the change to be effective.

Sometimes a subscriber notifying us of a change of address doesn't give us complete information about the old one. When this happens, the search for the old address plate consumes additional time. Your change will be made faster if we have the code line of letters and figures from your address label—or, even better, the label itself torn off an old issue.

Another point that causes trouble is the new address. When it is not complete, the post office cannot make delivery. And sometimes, surprisingly, we find that a subscriber gives us the wrong town or city in his new address. This is because a post office in one place may service a part of an adjoining municipality. But if you will give us enough advance warning, the complete new address and the complete old one, and the effective date, we will see that you get your copies of MECHANICAL ENGINEERING without delay or interruption. Keep us informed.

Manpower Shortage

THE current shortage of engineers will get progressively worse for some years to come, Dr. John T. Rettaliata, Vice-President, ASME, president of Illinois Institute of Technology, told Chicago teachers.

He cited the low birth rate in depression years and the draft, along with an erroneous 1950 statement by the Bureau of Labor Statistics that there was an over-supply of engineers, as factors causing the shortage.

Dr Rettaliata addressed the opening session of the 12th annual education conference of the Chicago Teachers Union in the Hotel Sherman. He spoke on "Education and a World in Conflict."

ASME Standards Workshop

Bolt and Nut Standards

AN American Standard B18.2-1952 on Square and Hexagon Bolts and Nuts has been prepared by ASA Sectional Committee B18, under the administrative sponsorship of ASME. In addition to providing new and improved standards that will greatly benefit American industry, the standard implements accord reached with British and Canadian standards groups in standardization for mutual defense purposes.

The task of reviewing, expanding, and modernizing the standard was assigned in 1947 to a subcommittee of specialists under the direction of the late C. F. Newpher of the National Screw and Manufacturing Company.

After an appreciable amount of review of the past standards and the requirements of American industry, tentative proposals were drafted by the subcommittee for consideration. The course of future events, however, was affected by inquiries from the British Standards Institution in the fall of 1949, proposing collaboration in the establishment of unified standards for bolts and screws.

After an exchange of preliminary comments, a conference was arranged in New York, N. Y., June 1-2, 1950, at which delegates of the three countries explored the desirability and practicability of similar standards for industrial purposes and the necessity for mutual defense.

The principal purpose of the conference was to seek, if possible, proportions of hexagonal bolts and nuts which could use the same-size wrenches in the three countries. The British delegation greatly simplified the problem by proposing selection of proportions from existing American Standards, but nevertheless this involved unification of somewhat dissimilar products and practices that had developed over the years in various branches of American industry.

After arriving at accord in this conference, it then became necessary to study possible effects in various applications, to consolidate requirements, to analyze and adjust relative proportions of successive sizes, and to modify the draft of the proposed American Standard. In making this study, the desirability of a change in two of the dimensions selected by the conference became apparent, and suggestions and justification were submitted to the United Kingdom delegation, after which the draft was submitted to industry for review and comment.

In the meantime, similar progress has been made in Britain where substantial agreement had been reached on acceptance of radical changes in British standards in an effort to secure unification with American ideas and practices. It also appeared practicable to them to extend the unification beyond across-

flats dimensions to include the other dimensions in the new draft of the American Standard to assure complete interchangeability of products of the three countries. An invitation was therefore extended to the American and Canadian standards bodies and to government agencies to attend a conference in London, April 26-27, 1951, to consider this possibility and to explain more fully to British industry the practices that had developed in the United States as reflected by the American Standards.

Much of the conference discussion was concerned with the proportions of the 7/16-size hexagon bolt which has had such extensive and critical use in the automotive industry that it was impractical to modify its proportions as originally desired by the British. Complete accord was reached on every point, and the willingness of the British to understand and to co-operate was abundantly demonstrated by the fact that all of the important motions to accept American practices were made by members of the United Kingdom delegation.

The London conference therefore was in accord with the proposals in the draft of the American standard as it had been prepared by Subcommittee No. 2 of B18. Subcommittee No. 2 thereupon completed editorial work and submitted the proposed standard to the Sectional Committee for letter-ballot approval and succeeding processing for designation as an American Standard. This approval was given on March 24, 1952. Copies of the standard are obtainable from ASME Order Department, 29 West 39th Street, New York 18, N. Y.

Junior Forum

Conducted by Joseph Schmerler[1]

Manpower in Defense Economy

THE combat in Korea may officially be designated as only a police action, but the fact remains that the United States and other friendly United Nations countries have considerable military forces committed there. Also, there are nearly a dozen other widely separated areas in the world where similar aggressions might occur. These conditions have precipitated a period of national emergency and produced the first peacetime mobilization this country has ever seen. The repercussions which this mobilization has evoked among engineering manpower were discussed at a meeting of ASME Juniors in Washington, D. C., on March 13, 1952.

In a talk given at this meeting, Prof. G. B. Thom, Mem. ASME, chairman, Newark College of Engineering, speaking on "Manpower Problems in Defense Economy," pointed out that the present national emergency is not completely similar to the situation as it existed at the start of World War II. At that time this country was faced with a tremendous military-equipment building program. Such a building program today is relatively unnecessary because of the great amount of World War II material which is still available and usable with slight modernization and modification. The arms production that is necessary consists of such material as new electronic devices, rockets and guided missiles, improved artillery pieces, jet aircraft, and the like.

For this reason, Professor Thom emphasized, production is not the big problem at the moment—manpower is. At the start of World War II, he said, there was a manpower reservoir of 8 million unemployed. Today there are about 2 million unemployed of which only 1,500,000 are employable. Present military needs are scheduled at 3,500,000 young men with a possible ultimate increase to 3,700,000. Nearly all of these will be in the age bracket 18 to 25. According to informed estimates, present inductions are not greatly in excess of the annual replacement needs. Agriculture needs are estimated at an additional 500,000 men and the defense industries will require up to 5 million more workers. As a conservative estimate, this adds up to at least 6 million more people than are gainfully employed today.

Womanpower may substantially alleviate this manpower need from a production point of view. However, so few women have technical or engineering training that their impact on this type of personnel need must be assumed to be of little effect. Only the schools can supply the needed engineers.

The latest and most reliable statistics developed by the Manpower Committee of the American Society for Engineering Education indicates that the number of high-school graduates decreased this year over last year, and will drop another 10 per cent by 1953. By 1958 the number of graduates will have risen again to last year's level.

With respect to engineering-college graduates the statistics are worse. Last June 38,000 and the year before 50,000 engineering graduates were absorbed by industry and the services. In contrast to this, the estimated number of graduates for the next three years is as follows: 1952, 21,900; 1953, 17,000; and 1954, 12,400.

Excluding defense needs and military inductions, the minimum estimated requirement is 20,000. Barring inductions, but including current defense efforts, a minimum need of 30,000 is estimated. The picture regarding engineer supply is thus most disheartening, even with modest defense plans.

With this in mind, the National Security Resources Board, in September, 1950, requested the Engineers Joint Council to prepare recommendations pertaining to the "most effective utilization of America's highly trained scientists and technologists in the event of a large-scale mobilization." This request led to the prompt formation of the EJC Engineering Manpower Commission comprised of 20 members of the several parent engineering societies, and the subsequent appointment by General Hershey of the "Six Committees" consisting of representatives of the engineering sciences, the agricultural and biological sciences, the humanities, the healing arts, the physical sciences, and the social sciences.

These committees have made a number of recommendations which until recently it appeared that Congress would accept and incorporated into suitable law. However, with recent congressional rebellion against the enactment of any military program to replace or modify the present Selective Service procedures, all of these proposals have been shelved, for the time being, at least.

Under these conditions, Professor Thom declared, the plight of the young engineer and of the young man with engineering aspirations needs special consideration. Of major concern to the young man approaching college age is whether to start college work at once or whether first to serve his stint in the armed services. While no single answer can be given to meet all contingencies it is important that the young man see the true picture with respect to engineering opportunities and his potential worth to the country as a more highly trained individual—as well as his obligation under the present Selective Service regulations.

The young man in college, pursuing a scientific or technical program, should be encouraged to put forth his best effort and to continue with his training until such time as he may be called to military service, for with additional training he will be worth infinitely more to the national security, health, and welfare. Under present draft quotas he will probably be deferrable until he receives a degree, provided he remains in good standing.

The graduate who has been out of college for one or more years and is now working in a defense industry should stick to it until called for military service. When and if his time does come to be called he should ask for the help of his boss in deciding whether he will be of greater value to his country in industry or in military service. In the meantime, he should continue with his education and develop his usefulness, whether his ultimate job is to remain in industry or to enter one of the services.

Those who are reserve officers have a somewhat different status, Professor Thom said. They have incurred an obligation to make themselves available in a time of need. Their usefulness will be a maximum if they can be assigned to a work for which they are best qualified. While the services do not deliberately misplace men, immediate need and specialized ability may make it necessary to place a man where his full talents are not being used to the maximum extent.

When and if inducted, the greatest hope for correct placement probably lies in Special Regulations 615, which have as their purpose the identification and assignment of critical or special professional abilities to the Technical Detachment, currently located at Fort Meyer, Va. To receive consideration, application must be made immediately upon induction. Screening and allocation, if needed, may be

[1] Design Engineer, Celanese Corporation of America, New York, N. Y. Jun. ASME.

expected in approximately four months.

In conclusion, Professor Thom urged all who are engaged in work of an engineering nature to take seriously to heart the fact that a colossal engineering and production job lies ahead with a confirmed shortage of skilled manpower to do the job. In every engineering job, not all of the work done is of such a nature as to require the full extent of the engineering talent devoted to it. Under these conditions, it seems to be absolutely imperative to scrutinize and analyze each job with minute care and to segregate those aspects requiring high-level engineering or scientific knowledge from those of a more routine nature which can be performed under supervision by others not possessing the training, skill, or over-all know how to do the job alone. Some companies have done this with marked success. Undoubtedly the practice can be more widely used with gratifying results and if done, can contribute materially to national security.

Engineering Societies Personnel Service, Inc.

These items are from information furnished by the Engineering Societies Personnel Service, Inc., in co-operation with the national societies of Civil, Electrical, Mechanical, and Mining and Metallurgical Engineers. This Service is available to all engineers, members or not, and is operated on a nonprofit basis. In applying for positions advertised by the Service, the applicant agrees, if actually placed in a position through the Service as a result of an advertisement, to pay a placement fee in accordance with the rates as listed by the Service. These rates have been established in order to maintain an efficient nonprofit personnel service and are available upon request. This also applies to registrant members whose availability notices appear in these columns. Apply by letter, addressed to the key number indicated, and mail to the New York office. When making application for a position include six cents in stamps for forwarding application to the employer and for returning when necessary. A weekly bulletin of engineering positions open is available at a subscription of $3.50 per quarter or $12 per annum for members, $4.50 per quarter for nonmembers, payable in advance.

New York, 8 West 40th Street — Chicago, 84 East Randolph Street — Detroit, 100 Farnsworth Ave. — San Francisco, 57 Post Street

Men Available[1]

Industrial Engineer, 27, married, BSME, MBA (production management). Two years' structural design and test experience; one year time study and operation analysis of shipping and salvage methods, and processes and designing of production-control systems. Any location. Me-873-5010-D-4.

Production Engineer, ME, Stevens, 1937. Production-engineering supervisor, 14 years' experience in the mass production of precise metal products. Knows tooling, methods, machine design, supervision. Me-874.

Mechanical Engineer, three years' industrial experience, shopwork, test, design. Courses in personnel relations, industrial psychology. Interested in human problems, personnel relations. Me-875.

Sales Engineer, 34, married, BME, two years sales electromechanical heavy equipment. Four years chemical-process industry, foreman and safety engineer. Will relocate. Me-876.

Mechanical Engineer, 26, single, N.Y.E.I.T. Certificate. Specializing in heat and power, more than three years' experience as assistant supervising engineer, including survey, analysis, design, and sales engineering. Prefers Northeast U. S. Me-877.

Assistant Construction Engineer, 27, married. Recent experience estimating extent and cost of building and mechanical-equipment repair, job specifications, inspection of job progress, background machine repair, boiler, erection, remodeling, and repair. Available immediately. Prefers West. Me-878-523-D-2.

Staff Engineer, 39, PE, stress analysis, heat transfer, electronics, national reputation, desires management position for applied research, product development, or project co-ordination. Me-879.

Positions Available

Mechanical Engineer, graduate, or ten to 15 years' experience, to prepare elaborate layouts of aircraft or missile components, make structural and aerodynamic analysis, and formulate his own plan of solving a problem. Upstate New York. Y-6390(*c*).

Designer, mechanical graduate, at least ten years' plumbing, heating, ventilating, and air-conditioning experience, to design and lay out mechanical facilities for buildings. $6500–$7800. New York, N. Y. Y-6772.

Engineers. (*a*) Chief tooling and processing engineer, tooling experience, preferably in aeronautical field, experience with gyro instruments useful, and extensive experience in processing. $9600–$11,400. (*b*) Production-control and planning engineer, strong procedureman, up to date on methods and inventory control, to assist in installing new systems. Position will lead to that of assistant general production manager. $7500–$8500. (*c*) Assistant factory manager, manufacturing and tooling experience. $8000–$10,000. New York metropolitan area. Y-6777.

Industrial Engineer, graduate, for work involving the tabulation and itemizing of all parts and operations in the production of sheet metal, glasswork, polishing and plating, and assembly, to be used as the basis of a system of production and purchasing control. Will also study the effect of incentive payment and job evaluation. Experience in all of this is essential, $6000. Conn. Y-6792.

Works Manager, 40–50, at least ten years' management and supervisory experience in light manufacturing or instrument field, to take full charge of production and engineering. $12,000–$15,000, bonus. New England. Y-6815.

Engineers. (*a*) Product engineer, mechanical graduate, at least five years' design, development, and application experience covering stainless-steel hardware, bolts, and accessories, to do product engineering and field sales for accessories manufacturer. Some traveling in East and Midwest. $8000–$8500. (*b*) Production engineer, at least ten years' machine-shop, stamping, and wire-forming experience in stainless-steel fields, to take full charge of production. $8000–$10,000. New England. Y-6834.

Mechanical Engineer, building-construction experience, to design and lay out piping, ventilating, and electrical work covering industrial and process construction for contractor. $5200–$6500. Long Island City, N. Y. Y-6840.

Chief Engineer, about 40, preferably with university or technical-school education. Must have had experience in business machines, calculators, or tabulating machines (product design). $12,000. Ohio. Y-6843.

Instructor in field of thermodynamics and power. Recent graduate with or without industrial experience if otherwise qualified. Master's work may be pursued while instructing. Also available, a fellowship in mechanical engineering toward master's degree. Position available September, 1952. $1200 plus tuition. Upstate New York. Y-6849.

Engineers. (*a*) Mechanical engineer, eight to ten years' experience in the textile field. Duties will consist of supervision of technical personnel, mechanical development investigations, and study evaluation of present methods of synthetic-fiber manufacture. To $10,000. (*b*) Mechanical or electrical engineer, under 45, BS or equivalent, experience in heating and ventilating. Two to five years' experience in design installation and maintenance of large installations of heating and ventilating as well as air-conditioning equipment. To $7000. (*c*) Instrument engineer, under 45, BS or equivalent in mechanical or electrical engineering, and considerable experience on all types of instruments used in chemical processing. Must be qualified to take full charge of all instrument installations, operations, and maintenance. To $7000. South. Y-6855.

Engineers. (*a*) Administrative engineer, mechanical or chemical graduate, at least five years' process-equipment design and staff experience, to take charge of engineering liaison. $8400. New York. (*b*) Liaison engineer, mechanical or electrical, 35–50. Should have design experience and knowledge of engineering-office procedures relative to industrial construction. $7000–$8300. Mich. Y-6860-D-7613.

Design Engineer, solid background in layout and design of high-speed rotating machinery, to work in development and production of commercial gas turbines. Should be able to follow up design through drafting room and assist draftsman in solving problems involving pattern shop, foundry, and machine-shop practice. $8000–$10,000, depending on experience. New York State. Y-6876.

Consulting Industrial Engineer, 15 to 20 years' experience in heavy industry, to examine and revaluate various industries, to produce efficient and productive operations. Six months' minimum work. $15,000–$18,000. Overseas. Y-6885.

Utility Engineer for position as administrative vice-president. Must have had considerable administrative experience and be familiar with costs, budgets, construction, operations, etc. $20,000. East. Y-6889.

Master Mechanic, strong administrative experience as well as tooling experience, for a plant which is part of a multiplant operation manufacturing precision and semiprecision parts and instruments for the aviation industry. Will be responsible for the complete supervision of all tooling and processing operations in a plant employing over 7000 personnel. About $10,000. New York metropolitan area. Y-6896.

Director of Engineering, mechanical or aeronautical-engineering graduate, under 50, at least ten years' design experience covering aircraft-fuel systems and accessories. $15,000–$20,000. Midwest. Y-6898.

Plant Engineer, 35–45, mechanical graduate, ten years' or more experience supervising construction, installation, and maintenance of mining, milling, transportation, power, and general industrial buildings and equipment. $9600, plus house. Three-year contract. South America. Y-6904.

Methods Engineer, five years' experience in machine-shop practice and process engineering. Some traveling. $6000–$8000, plus living allowance. Headquarters, New York, N. Y. Y-6910.

Engineers. (*a*) Chief engineer, 35–43, minimum of ten years' experience supervising design application, sales manufacturing. Knowledge of air and hydraulics in industrial applications. Will take complete charge of air and hydraulic department of well-established company, representing some leaders in air and hydraulic fields. Company not only sells components for their principals, but also designs circuits and builds package-power units. $7500 and up. Company will negotiate placement fee. Limited traveling. Car required. (*b*) Sales engineer, 30–40, graduate, seven years' experience in sheet-metal forming and fabricating, including experience with stampings, presses, press brakes, and resistance welding. Experience should include both sales and manufacturing if possible. Duties will include sales engineering with established sales-engineering firm, contacting industrial accounts. $6000, and up. Traveling, car required. Company will negotiate placement fee. Mo. T-8748.

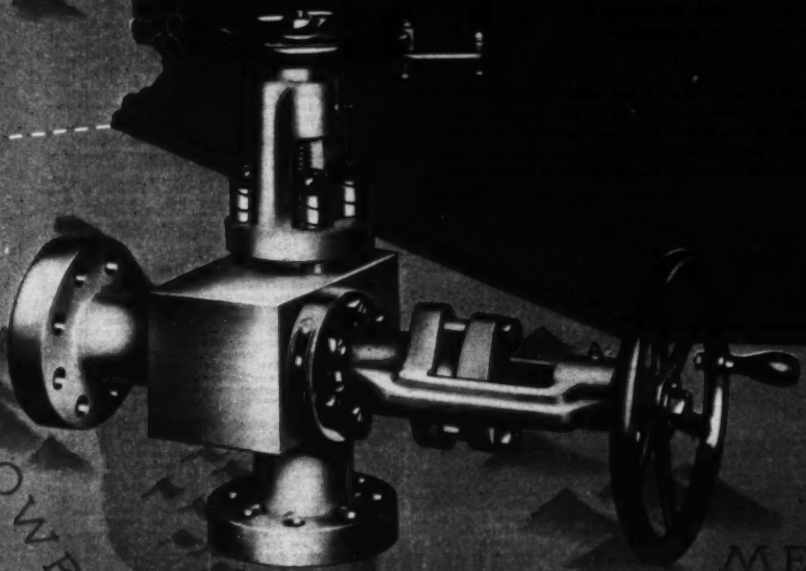
Tool Engineer, to 50, six years' experience in tooling engineering. Familiar with small electrical-appliance manufacturing or related fields. Knowledge of shopwork and tools and dies. Will prepare operational standards, prescribe tool-design and machine requirements, supervise procurement of machine tools; follow jobs through production stage for manufacturer of appliances. Up to $8000. Company will pay placement fee. Ill. R-8756(*b*).

(*Continued on page 440*)

[1] All men listed hold some form of ASME membership.

ALSO IN ARIZONA, IT'S YARWAY

YARWAY UNIT TANDEMS



YARWAY SERVICE GOES ALL THE WAY....

Engineers. (*a*) Chief engineer, mechanical, four years' experience in production equipment, both design and maintenance. Knowledge of fast-moving automatic machinery. Take complete charge of engineering for a company making large volume of small items such as matchbooks, for a manufacturer. Up to $15,000. Company will negotiate fee. (*b*) Project engineer, mechanical, up to 45, three years' experience designing light automatic and fast-moving machinery such as paper converying equipment. Knowledge of printing equipment helpful. Duties will include project-work designing, supervising building, installing, and maintenance of fast-moving, light, automatic machinery making items similar to matchbooks for a manufacturer. Employer will negotiate fee. Up to $8000. Ill. R-8766.

Specification Engineer civil or mechanical, five years' experience writing specifications for steel plants and equipment. Will write specifications for steel plants and equipment. $7200–$8500. Employer will negotiate placement fee. Ill. R-8768.

Candidates for Membership and Transfer in the ASME

THE application of each of the candidates listed below is to be voted on after May 26, 1952, provided no objection thereto is made before that date and provided satisfactory replies have been received from the required number of references. Any member who has either comments or objections should write to the secretary of The American Society of Mechanical Engineers immediately.

KEY TO ABBREVIATIONS

R = Re-election; Rt = Reinstatement; Rt & T = Reinstatement and Transfer to Member.

NEW APPLICATIONS

For Member, Associate, or Junior

ALEXANDER, RUSSEL C., Long Beach, Calif.
ALEXANDER, WILLIAM M., Jr., Berkeley, Calif.
ATTWELL, WILLIAM H., New Castle, Del.
BARCLAY, HARTLEY W., Port Chester, N. Y.
BARR, GEORGE T., New York, N. Y.
BARKOCY, JOHN L., Cuyahoga Falls, Ohio
BARR, ROBERT S., Pueblo, Colo.
BEHRENS, CHARLES W., Chicago, Ill.
BOOSTER, EDGAR F., New Orleans, La.
BORG, MATTHEW F., Washington, D. C.
BORIE, H. PETER, Jr., Philadelphia, Pa.
BOTHE, MERREDITH, Charleston, W. Va.
BRADBURN, JOHN E., Robbinsdale, Minn.
BRUSH, MARION G., Cuyahoga Falls, Ohio
BURTON, WILLIAM H., Wiscasset, Me.
CAMBRIDGE, JOHN D., Wilmington, Del.
CASSEY, HAROLD C., Allentown, Pa.
CHAPEL, RAYMOND E., Stillwater, Okla.
CHAPMAN, JOHN L., Greenville, S. C.
CHAYNE, CHARLES A., Detroit, Mich.
CHRIST, ERWIN, New York, N. Y.
CLARKE, ROLLIN R., Waterbury, Conn.
CRAMER, JOHN W., Lincoln, Neb.
CUMMINGS, E. S., Jr., Greenville, S. C.
CURTIS, WILLIAM E., Massillon, Ohio
DALEY, HENRY F., Philadelphia, Pa.
DATSKO, JOSEPH, East Ann Arbor, Mich.
DECKER, JAMES D., State College, Pa.
DE KONING, PAUL J., East Lansing, Mich.
DEMIRCOGLU, D. V., Istanbul, Turkey
DE MOCSKONYI, E. S., Whittier, Calif.
DEVERALL, JOHN E., W. Lafayette, Ind.
DONOVAN, GENE, Inglewood, Calif.
DOUSMAN, ALBERT C., Baldwin, N. Y.
DUDA, ROBERT F., Wilson, Conn.
DUNN, THOMAS J., New York, N. Y.
ELLIOTT, EDUARD M., Los Angeles, Calif.
FRANTZ, PAUL E., Encino, Calif.
FRIES, JOHN H., Jr., Schenectady, N. Y.
GANATSIOU, THOMAS J., Trumbull, Conn.
GERDES, CHARLES W., Jr., Borger, Texas
GRANT, R. J., Chicago, Ill.
GRRIF, LUCIEN R., New York, N. Y.
GRIMALDI, SAMUEL J., Saginaw, Mich.
GUTHRIE, CHARLES J., Waukesha, Wis.
HALL, WILLIAM O., Akron, Ohio
HANSEN, ERNEST K., Jr., New Castle, Del.
HANSON, ARNOLD A., Wheaton, Ill.
HARKINS, JOHN J., Youngstown, Ohio
HARRINGTON, J. EARL, Chicago, Ill.
HARRIS, FRITZ B., E. Lansing, Mich.
HARRIS, STEVEN, Los Angeles, Calif.
HEASTON, GAYLORD E., Beloit, Wis.
HOLMES, RALPH E., Norwood, Ohio
HORGAN, JOSEPH B., Wilmington, Del.
HOUCK, HUGH N., Youngstown, Ohio
HUMPHREY, ROBERT P., Kalamazoo, Mich.
IMBERALL, ARTHUR E., Washington, D. C.
JACKSON, GATEWOOD D., Omaha, Neb.
JILANI, TAJ, Rawalpindi, Pakistan
KANE, JOHN M., Louisville, Ky.
KLEINRATH, ARTHUR W., Elmhurst, Ill.
KNIGHT, WILLIAM E., Brighton, Mass.
KNOCK, LLOYD L., Le Sueur, Minn.
KORNER, H. J., Shreveport, La.
KULJIAN, ARTHUR H., Ridley Park, Pa.
LAYTON, GEORGE H., Vallejo, Calif.
LEONARD, CLAIR R., Boardman, Ohio
LIBBY, W. EDWARD, Jr., Great Neck, N. Y.
LITTON, MARSHALL T., Cincinnati, Ohio
LONOLEY, JOHN H., Detroit, Mich.
LOWDER, LEONARD RAY, Omaha, Neb.
MA, JOSEPH TOA-SENG, Lubbock, Texas
MACKINNON, DONALD L., Lewiston, Idaho
MATNEY, CLAYTON, Schenectady, N. Y. (Rt & T)
MCDONALD, L. D., Kansas City, Mo.
METTER, CALVIN E., Akron, Ohio
MEYERS, ROBERT S., Buffalo, N. Y.
MONK, MARVIN E., Jr., Kansas City, Mo.
MONROE, WILLIAM R., Redondo Beach, Calif.
MOROWSKI, JOHN V., Boston, Mass.
MORRIS, ROBERT J., Evanston, Ill.
MURUGESAN, SHANMUGHAM, Vepery, Madras, India
NIEMEYER, EDWARD R., Texas City, Texas
ONSAGER, KNUT H., Ridgewood, N. J.
OSMOND, CHARLES W., Cincinnati, Ohio
PAGENDARM, HAROLD C., Belmont, Calif.
PEARCE, CULLEN, Philadelphia, Pa.
PETRONE, THOMAS D., N. Valley Stream, L. I., N. Y.
PORTER, CHARLES C., New York, N. Y.
POWELL, ALAN E., Hexham, Northumberland, England
POWERS, JOSEPH H., Farmington, Conn.
PRESSLEY, W. H., Jr., Tulsa, Okla.
RAUSCHENBERGER, FRED, Akron, Ohio
REILLY, JOHN J., Schenectady, N. Y.
REINHARDT, THOMAS A., Albuquerque, N. Mex.
RICH, H. ROLAND, Providence, R. I.
RIDLEY, PAUL S., Newport, R. I.
RIESLAND, JOHN I., Napa, Calif.
RIGGAN, FRED B., East St. Louis, Ill.
RINK, RALPH E., Chicago, Ill.
ROBERTS, JOHN M., Richland, Wash.
SABOUNI, BAHIDGE B., Oakland, Calif.
SAKOLS, D. JAMES, St. Paul, Minn.
SCHOENBAUM, CARL F., Canton, Ohio
SEARSON, JAMES G., Pittsburgh, Pa.
SEDILLE, MARCEL, Paris, France
SELIGMAN, ARTHUR J., Chicago, Ill.
SHAFFER, AARON, Roxbury, Mass.
SIMISTER, WALTER, Jr., Greenville, S. C.
SMITH, J. ED, Pelzer, S. C.
SQUIER, JOHN, Dallas, Texas
STALLKAMP, A. L., South Pasadena, Calif.
STILLWELL, R. F., Columbus, Ohio
STITT, CLAUDE M., Antioch, Calif.
STOVALL, JOSEPH H., Grand Prairie, Texas
TAUBER, EDWARD J., New York, N. Y.
TODD, LEONARD M., New York, N. Y.
TRAVIS, RUSSELL E., Jr., Alexandria, Va.
TULLO, CHARLES J., S. Orange, N. J.
VALLIER, A. E., Jr., Plymouth, Mich. (Rt & T)
VIVALO, JOSEPH F., Youngstown, Ohio
WAHID, ABDUL, Lahore, Panjab, West Pakistan
WELLS, CHARLES A., Burlington, N. C.
WEST, EUGENE E., Washington, D. C.
WIGGS, JAMES S., Long Beach, Calif.
WILKING, ROBERT L., Brady Lake, Ohio
WYLLY, WILLIAM B., Atlanta, Ga.

CHANGE IN GRADING

Transfers to Member and Associate

BARTLETT, HENRY G., Alliance, Ohio
BRADBURY, DONALD, Kingston, R. I.
BUTLER, C. A., Jr., Painesville, Ohio
DOERING, JOHN, Philadelphia, Pa.
ELSEVIER, ERNEST, Hillsboro, N. C.
ESPOSITO, DANIEL J., Bridgeport, Conn.
FOWLES, GEORGE M., Indianapolis, Ind.
FREIBERG, JAMES M., New Kensington, Pa.
GALBREATH, PAUL J., Kingsport, Tenn.
HEMENWAY, HENRY H., New York, N. Y.
HOFFMAN, MILTON H., Jr., Bettendorf, Iowa
JACK, WILLIAM A., Denver, Colo.
KING, RUSSELL N., S. Norwalk, Conn.
MCMAHON, CHARLES M., Westboro, Mass.
MARSH, HERBERT W., East Chicago, Ind.
PACEY, JOHN J., Springfield, Mass.
ROBINSON, CUDVILLE P., New York, N. Y.
RIZZONE, MICHAEL L., Oil City, Pa.
ROSCHER, ALFRED M., Conyngham, Pa.
SCHERR, EUGENE F., Chicago, Ill.
SCHMELZ, WILLARD F., Bronx, N. Y.
SCHUG, KENNETH W., East Syracuse, N. Y.
SHEPPARD, W. L., Glenside, Pa.
STUMBERG, ANDREW W., Homeworth, Ohio
WEBB, THOMAS C., Jr., Caracas, Venezuela

Transfer Student Member to Junior 300

Obituaries

Florence Cotter Biggert, Jr. (1878–1952)

F. C. BIGGERT, JR., chairman of the board, United Engineering and Foundry Co., died Feb. 10, 1952, in Alleghany General Hospital, Pittsburgh, Pa. Born, Crafton, Pa., Aug. 20, 1878. Parents, Florence C. and Lavinia F. (Patterson) Biggert. Education, ME, Western University of Pennsylvania (University of Pittsburgh), 1899. Married Edna Rossey; children, George M. and Rody P. Mem. ASME, 1915; Fellow ASME, 1948. He was one of the pioneers in the design of continuous strip mills for the steel industry and held approximately 100 U. S. patents.

Herbert Ferdinand John Finck, Jr. (1927–1951)

HERBERT F. J. FINCK, Jr., area engineer, Savannah River Project, E. I. du Pont de Nemours and Co., Inc., died Aug. 3, 1951. Born, Jersey City, N. J., Oct. 18, 1927. Parents, Herbert F., Mem. ASME, and Elizabeth L. Finck. Education, ME, Stevens Institute of Technology, 1948. Jun. ASME, 1948. Survived by his parents and a sister, Mrs. Theodore Leibfried, Jr., Stanford, Calif.

Charles H. Frazier (1907–1951)

CHARLES H. FRAZIER, district manager, The Torrington Co., Cleveland, Ohio, died Nov. 19, 1951. Born, New Philadelphia, Ohio, Aug. 23, 1907. Education, BS(ME), Tri-State College of Engineering, Angola, Inc., 1934. Mem. ASME, 1948. Survived by mother, Esther A. Frazier.

Francis Hegenbarth (1883–1952)

FRANCIS HEGENBARTH, consulting engineer, Vulcan Iron Works, Wilkes-Barre, Pa., died Feb. 26, 1952, at St. Petersburg, Fla. Born, Vienna, Austria, Dec. 6, 1883. Parents, Franz and Anna (Gabriel) Hegenbarth. Education, 2 years, technikum, Ilmenau, Thuringia; 1 year, academy, Arnstadt, Thuringia; 2 years, technical university, Vienna, Austria. Naturalized U. S. citizen, Honolulu, Hawaii, 1917. Married Martha Zorn, 1912; son, Theodore. He held several U. S. Patents on sugar-mill machinery and was author of many technical articles on the subject.

Vincent C. George (1892–1951)

VINCENT C. GEORGE, physics instructor, Los Angeles (Calif.) City College, died July 21, 1951. Born, Cumro, Neb., Nov. 9, 1892. Parents, N. C. and Ruth E. George. Education, BS(ME), University of Nebraska, 1916; ME, 1928. Married Marion Gillespie; children, Paul P. and Raymond G. Mem. ASME, 1931. Author of "Advanced Shop Drawing," 1920; several articles on fans.

George Franklin Huff (1886–1951)

GEORGE F. HUFF, retired owner, Engineering Products Co., Pittsburgh, Pa., died Dec. 8, 1951, at Kennedy Mill Hill, Portsville, Pa. Born, Greensburg, Pa., Jan. 15, 1886. Parents, William A. and Kate E. (Heller) Huff. Education, PhB, Sheffield Scientific School, Yale University, 1909. Married Elsa Mary Steiner, 1921; children, George F., William S., and Elizabeth S. Mem. ASME, 1926.

Olof Karnekull (1885–1950)

OLOF KARNEKULL, whose death in June, 1950, was recently reported to the Society, was director, chief engineer, Federation of Swedish Industries, Stockholm, Sweden. Born, Jönköping, Sweden, Oct. 25, 1885. Education, state high school and college, Jönköping, 1907; The Royal Institute of Technology, Stockholm, 1908–1912. Assoc. Mem. ASME, 1921; Mem. ASME, 1935. Author of a number of technical articles on industrial management and in 1921 had a book published on scientific management.

Morris Woodruff Kellogg (1873–1952)

MORRIS W. KELLOGG, chairman of the board, M. W. Kellogg Co., petroleum-refinery engineering firm, and several others, died Feb. 22, 1952, at his home in New York, N. Y. Born, Elizabeth, N. J., Jan. 16, 1873. Parents, James C. and Elizabeth (Woodruff) Kellogg. Education, ME, Stevens Institute of Technology, 1894. Married Marie Winthrop, 1910. Mem. ASME, 1913. Survived by wife and two daughters, Mrs. Helen Edey and Mrs. Beatrice McClintock; and a sister, Mrs. Bertha Barstow.

George Frederick Kidd (1874–1952)

GEORGE F. KIDD, mechanical and structural engineer, East Orange, N. J., died Jan. 30, 1952.

(*Continued on page 442*)

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Part of an installation of nine R-C Positive Displacement Meters in large chemical plant. Capacities from 2,000 cfh to 130,000 cfh.

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Capacity—from 4,000 cfh to 1,000,000 cfh in one unit, to meet practically any industrial metering requirements. Ample ability to absorb overloads.

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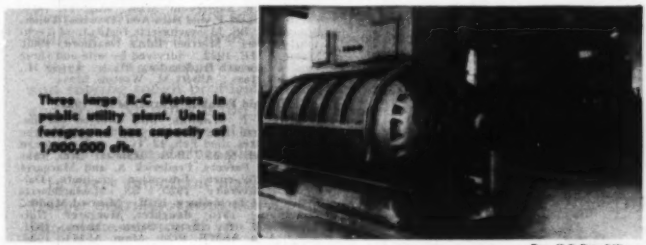

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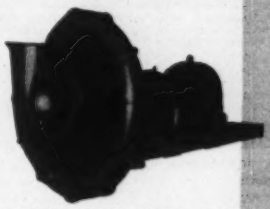
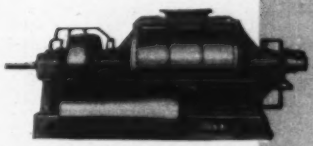


Single-Stage Centrifugal Blowers

Rotary Positive Blowers



Rotary Positive Gas Pumps

Positive Displacement Meters

Inert Gas Generators

Born, Chelsea, Mass., Aug. 1, 1874. Parents, James B. and Annie (Bramble) Kidd. Education, ME, Stevens Institute of Technology, 1898. Married Edith E. Bennett, 1900; children, Marion (Mrs. C. R. Rosevear, Jr.) and Alice E. Mem. ASME, 1915.

Ralph Davenport Mershon (1868–1952)

RALPH D. MERSHON, consulting electrical engineer and inventor, died at his home in Miami, Fla., Feb. 14, 1952. Born, Zanesville, Ohio, July 14, 1868. Parents, Ralph S. and Mary J. (Jones) Mershon. Education, ME, Ohio State University, 1890; DS, Tufts College, 1918; DE, Ohio State University, 1936. He designed transformers for the Westinghouse Co., one of which won an award for the company at the Chicago exposition in 1893. He invented the six-phase rotary converter; compounded rotary converter; system of lightning protection for electrical apparatus; and compensating voltmeter, for which he was awarded the John Scott medal by The Franklin Institute. Mem. ASME, 1900. He was president of AIEE, 1912–1913; a former president of the Inventors Guild; and member or fellow of several other technical and professional societies.

George Alexander Nicol, Jr. (1883–1951)

GEORGE A. NICOL, JR., retired former executive vice-president, Johns-Manville Corp., died Dec. 16, 1951, at his home in Palm Beach, Fla. Born, Providence, R. I., July 21, 1883. Parents, George A. and Mary (Finlayson) Nicol. Education, high-school graduate; Rhode Island School of Design. Married Jeanie S. McVicar, 1905. Assoc-Mem. ASME, 1914; Mem. ASME, 1935. Survived by wife and daughter, Mrs. Lucius S. Storrs, Jr.

Harry Miller Pflager (1866–1951)

HARRY M. PFLAGER, retired director, General Steel Casting Corp., St. Louis, Mo., and pioneer in the development of large integral castings primarily for railway locomotives and cars, died Oct. 28, 1951. Born, St. Louis, Nov. 29, 1866. Parents, Henry W. and Jessie (Miller) Pflager. Education, St. Louis Manual Training School; Washington University. Married Alyce Louise Barber, 1893; one son, Henry B. Mem. ASME, 1933; Fellow ASME, 1944; Hon. Mem. ASME, 1950. In 1904 he associated with C. H. Howard in the founding of the Commonwealth Steel Co., St. Louis (and with its successor, General Steel Casting Corp.), becoming its senior vice-president. Mr. Pflager, who was in charge of engineering and operations, was largely responsible for the contribution which this company made, not only to the railroads, but to heavy industry generally. The trails which he blazed pointed the way to and encouraged the use of large cast-steel structures in the heavy-machinery field. He was granted several hundred patents in this field in addition to those obtained on the locomotive bed. Among these are the 4-wheel and 6-wheel passenger-car trucks with frames cast in one piece. He developed the cast armor one-piece top hulls for combat tanks used during World War II. In 1943 he was awarded the G. R. Henderson medal by The Franklin Institute for the development of the one-piece cast-steel bed, an outstanding feature of modern locomotives. Nearly all locomotives built during the past 25 years, steam, electric, and Diesel-electric, have embodied the principles of integral cast-steel design as first initiated by Mr. Pflager. Through his support of Iberia College, Iberia, Mo., which was established for the farm boys of the Ozark Mountain district, he had helped many worthy young men obtain a higher education. He had been a trustee and benefactor of this institution. He was also a trustee of Drury College, Springfield, Mo., conducted under the auspices of the Congregational Church and had done much of its upbuilding.

Heyman Rosenberg (1874–1952)

HEYMAN ROSENBERG, founder, officer, and director, Parker-Kalon Corp., New York, N. Y., died Feb. 29, 1952. Born, Dunaburg, Kurland, Latvia, April 15, 1874. Education, 8 years, schools at Dunaburg; N. Y. Trade School. Mem. ASME, 1927. He was the originator and patentee of self-tapping screws, which are used in the fabrication of automobiles, aircraft, radios, television sets, refrigerators, and other metal and plastic products. He had been granted over 200 U. S. and foreign patents. Most of them covered screws of various types and machinery for their production. He was the recipient of many engineering honors, including an award by The Franklin Institute and the pioneer inventor's award from the National Association of Manufacturers. Survived by wife, Jennie; four daughters, Mrs. Florence Brimberg, Mrs. Annie Ritter, Mrs. Helen Greenman, and Mrs. Mildred Slifka; and a brother, Philip.

Charles Jay Seibert (1880–1952)

CHARLES J. SEIBERT, retired design and structural engineer, Washington, D. C., died Feb. 6, 1952. Born, Brooklyn, N. Y., July 23, 1875. Parents, Jacob and Mary (Reichel) Seibert. Education, Pratt Institute; CE, Rensselaer Polytechnic Institute, 1911. Married Mary Alice Dirreen, 1913. Mem. ASME, 1924. He spent approximately 35 years in Brazil. Among his notable works are the Ipanema-Leblon Bridge, U. S. Department of State building, Rio de Janeiro; the first tall office building in São Paulo. Survived by wife and son, Lt. Col. C. J. Seibert, USMC, at present with the U. S. Naval Mission to Brazil.

George Aymar Taber (1870–1951)

GEORGE A. TABER, president, Pennell, Dearborn and Hovey, Inc., Lynn, Mass., died Nov. 30, 1951. Born, Somerville, Mass., Aug. 14, 1870. Parents, Albert P. and Sara Ada (Downes) Taber. Education, BS, Massachusetts Institute of Technology, 1894. Married Edna Dearborn, 1900. Mem. ASME, 1922. Survived by wife and three sons, Wentworth D., Reading, Mass.; Aymar H., Bedford, Mass.; Albert M., Weston, Mass.

Donald Franklin Warner (1898–1952)

DONALD F. WARNER, who directed the development of the first jet engine built in the United States, died Feb. 12, 1952, at his home in Marblehead, Mass. Born, Halifax, Can., June 14, 1898. Parents, Frederick A. and Margaret (Murray) Warner. Education, graduate, Dalhousie University, 1920; BS, Massachusetts Institute of Technology, 1922. Married Mildred Whitehouse, 1926; daughter, Margaret. Naturalized U. S. citizen, Salem, Mass., 1931. Assoc-Mem. ASME, 1926; Mem. ASME, 1935. One of the nation's pioneer jet engineers, he was employed throughout his career by the General Electric Co. at Lynn. He received the C. A. Coffin award in 1946, and in 1949 the ASME Gas Turbine Power Division award. He was co-author of "Contemporary American Gas Turbines for Jet Propulsion." Thirty U. S. patents were granted to him covering steam-turbine construction and controls, on gas-turbine superchargers and their controls, and others.

Keep Your ASME Records Up to Date

ASME Secretary's office in New York depends on a master membership file to maintain contact with individual members. This file is referred to dozens of times every day as a source of information important to the Society and to the members involved. All other Society records and files are kept up to date by incorporating in them changes made in the master file.

From the master file are made the lists of members registered in the Professional Divisions. Many Divisions issue newsletters, notices of meetings, and other materials of specific interest to persons registered in these Divisions. If you wish to receive such information you should be registered in the Divisions (no more than three) in which you are interested. Your membership card bears key letters opposite your address which indicate the Divisions in which you are registered. Consult reverse side of card for the meaning of the letters. If you wish to change the Divisions in which you are registered, please notify the Secretary's office.

It is important to you and to the Society to be sure that your latest mailing address, business connection, and Professional Divisions enrollment are correct. Please check whether you wish mail sent to home or office address.

For your convenience a form for reporting your address, business connection, and Professional Divisions enrollment is printed on this page. Please use it to keep the master file up to date.

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This famous "Fair Offer" has been published at frequent intervals for the past 83 years. It can be repeated, again and again, only because all Jenkins Valves measure up to its sincere pledge of exceptional dependability.

Despite their *extra value,* proved by countless economy records in every type of service, *you pay no more* for Jenkins Valves. Jenkins Bros., 100 Park Ave., New York 17.

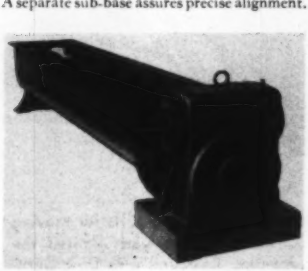
Keep Informed

New Equipment

Speed Reducer

Boston Gear Works, Quincy 71, Mass., announces a new Boston Reductor, Model C9-U52, for quick, convenient application and efficient operation of the widely used 9-in-diam screw-feed conveyers.

As the picture shows, this Boston Reductor (speed reducer) is equipped with a built-in adapter flange for ready installation by direct mounting with the conveyer trough. A separate sub-base assures precise alignment.



These special Boston Reductors are also furnished with special diameter output shafts at slightly higher cost, and will likewise be available for other standard sizes of screw-feed conveyers.

Full specifications and information on the range of gear ratios, input horsepower, output rpm, rated output horsepower and torque at input rpm of 1800, 1200, 600, and 300 will be supplied by Boston Gear Works on request. Like all Boston Gear power transmission equipment and parts the Model C9-U52 Reductors for screw-feed conveyers will be available from near-by stocks maintained by authorized Boston Gear distributors located in industrial centers throughout the nation.

Electronic Caliper

A new No. 955 electronic caliper for in-the-machine measurements has been announced by Brown & Sharpe Mfg. Co., Providence, R. I.

The No. 955 electronic caliper is for use with No. 950 Brown & Sharpe electronic amplifier. This caliper makes possible high precision gaging of work in units varying from 0.0001 to 0.00001 in. with the workpiece either on the bench, in the fixture, or in the machine.

The capacity or range of measurements from 0 to 4 in. is made possible by four interchangeable jaws for the caliper body. Each jaw has a range of 1 in. and is provided with an adjustable back rest to make the caliper self-centralizing.

Four aligning attachments are available, also, one for use with each jaw and these attachments are particularly desirable when long workpieces are being measured. The aligning attachments are furnished as extras and are provided with separate spherically faced measuring points interchangeable with the flat points used regularly on the adjustable arm of jaw. As the measuring point on the caliper body is spherical, the employment of an upper spherical measuring surface provides a three-point bearing when the aligning attachment is employed. Aligning attachment may be used on either side of caliper.

The caliper is unaffected by moisture or dust and is adjusted easily and quickly. Pressure is factory set at 2 lb and is adjustable from 1 to 5 lb. Only one master is required for setting or checking the caliper.

Measuring faces are tungsten carbide. Caliper has a dull chrome and aluminum finish with knurled plastic insulation pads attached to each side of caliper body and jaws for convenience in handling caliper and to minimize the effect of heat from the hands. Furnished with 7 ft of light flexible cable and connector for amplifier.

No. 955 electronic caliper is furnished in four separate sizes: 0 to 1 in., 1 to 2 in., 2 to 3 in., and 3 to 4 in.

Interchangeable jaws for each one of these ranges are also furnished separately and aligning attachments complete with spherical measuring faces also are furnished as extras for jaws in each size.

Key-Operated Push Buttons

New key-operated cylinder locks for oil-tight push buttons are available from Westinghouse Electric Corp., Pittsburgh, Pa.

These cylinder locks come in two basic types: The selector switch, which has either 2 or 3 rotary positions; or the push-button type, which can be depressed in either full or intermediate positions. Several models cover virtually all possible conditions. For example, the push-button type allows the key to be removed in the depressed position, in the undepressed position, or in both; and, similarly, the selector-switch type allows the key to be removed in any or all positions.

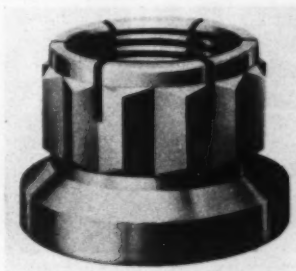
These cylinder locks are mounted in place of the standard operator on Class 15-022 Oil-Tite push buttons for panel mounting, or in surface-mounting or flush-mounting stations. All operators of the complete Oil-Tite line are mounted in identical round holes in panels varying in thickness from $^1/_{16}$ to $^1/_4$ in. without requiring an extra gasket.

The single or double-pole contact blocks can be mounted either in the bottom of the box or on the operator.

External Wrenching Nut

Originally designed for aircraft use, an external wrenching nut made by Standard Pressed Steel Co., Box 558, Jenkintown, Pa., can be applied wherever space is at a premium and high tensile strength is a must.

This Flexloc nut combines extreme strength with minimum size and weight. The tensiles are consistently in excess of 160,000 psi. For example, the $1^1/_4$-in. size has a minimum tensile of 193,700 lb, yet weights only 0.52 lb. Designed with a large bearing surface, it has 12-point serrations to fit standard box or socket wrenches for convenience in restricted space and close clearances.



Because it does not have to seat to lock, the Flexloc is a stopnut as well as a locknut, locking securely in any position on a threaded member. Furthermore, its all-metal, one-piece construction permits its use at temperatures as high as 550 F without loss of locking efficiency.

Under latest government specifications for aircraft, the Flexloc external wrenching nut is approved in sizes from $^1/_4$ in. to $1^1/_2$ in. in the NF thread series.

General-Purpose Oscillograph

The Instrument Division of Allen B. Du Mont Laboratories, Inc., Clifton, N. J., has announced a new dual-beam oscillograph, engineered specifically for general-purpose laboratory and industrial applications. Designated the Du Mont Type 322 dual-beam oscillograph, this compact instrument is essentially two Du Mont Type 304-H oscillographs in a single cabinet, and offers all of the features of the famous Type 304-H, with the additional advantage of dual-beam presentation on either common or individual sweeps, amplitude calibration of either axis of both channels, and conveniently centralized controls.

The Type 5SP-Cathode-ray tube employed in the Type 322 is operated at an over-all accelerating potential of 3000 volts, produc-

DOW CORNING SILICONES

give motors more muscles

(Photo courtesy National Electric Coil Co.)

On the hoist motor outlined above Class B insulation failed 18 times in less than 8 years. Rewound with Class H insulation made with Dow Corning silicones, the motor is still in excellent operating condition after 4 years of uninterrupted service.

LOOK AT THE RECORD

DATE AND CAUSE OF FAILURE

2/21/40 Armature coils grounded	7/28/45 Armature coils grounded
12/29/40 Armature coils grounded	9/14/46 Armature coils grounded
9/2/41 Open armature circuit	2/6/47 Armature coils grounded
4/13/42 Armature coils grounded	6/23/47 Armature coils grounded
4/18/42 Leads loose in commutator	9/17/47 Armature coils grounded
10/24/42 Armature band thrown	11/4/47 Armature band thrown
4/5/43 Armature coils grounded	12/26/47 Armature coils grounded
8/9/43 Open armature circuit	1/7/48 Rewound with Class H
10/7/43 Armature coils grounded	1949 No failure
9/30/44 Armature coils grounded	1950 No failure
10/18/44 Armature coils grounded	1951 No failure

CLEARING away the "overburden" in strip mining calls for moving a lot of dirt and digging into solid rock. Excessive overloads limited the service life of this main hoist motor to 5 months. Rewound with Dow Corning Silicone (Class H) insulation, the motor has already outlived its previous service record almost 10 times; has prevented at least 9 costly breakdowns at an estimated down-time rate of $1000 per hour.

That kind of performance has been repeated in thousands of different installations. That's why more and more production men in varied industries are insisting upon Class H insulation for their hard working motors. These may be critically important motors; motors subject to frequent overloads; motors operating in high ambient temperatures or exposed to a combination of heat and damp or corrosive atmospheres.

Users of Dow Corning Silicone (Class H) insulation are finding that it pays for itself over and over again. In fact, life expectancy of Class H insulation made with Dow Corning silicones is in the range of 4 to 100 times the life of Class B insulated equipment under comparable operating conditions. And Class H costs little more than the second best class of insulation.

For complete information on Class H Insulation, list of rewind shops or sources of supply, call our nearest branch office or write Dept. Q-17.

DOW CORNING CORPORATION

MIDLAND • MICHIGAN

DOW CORNING SILICONES

Atlanta
Chicago
Cleveland
Dallas
Los Angeles
New York
Washington, D. C.

In Canada: Fiberglas Canada Ltd., Toronto

Great Britain: Midland Silicones Ltd., London

ing a bright trace capable of excellent resolution. Stable high-gain a-c and d-c amplifiers are provided for both axes. Sinusoidal frequency response of the X and Y axes of both channels is down not more than 10% at 100,000 cps, and down not more than 50% at 300,000 cps, with a deflection factor of 0.028 peak-to-peak volts per in. on the vertical axis and 0.28 peak-to-peak volts per in. on the horizontal axis.

Driven and recurrent sweeps are continuously variable from 2 to 30,000 cps. Complementing the d-c response of the vertical axes, sweeps of extremely long duration can be made available by connecting an external capacitance to convenient front-panel binding posts.

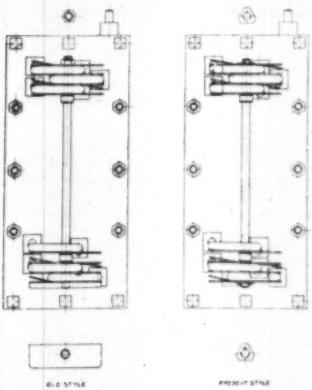
Owing to the ingenious mechanical layout of the Type 322, as well as to the use of concentric controls, this new dual-beam instrument is no larger than many standard, 5-in., single-channel oscillographs. Additional features include an illuminated calibrated scale with a dimmer control, and balanced input at maximum sensitivity, in addition to the conventional single-ended input.

In every respect, the new Type 322 meets the need for a truly versatile, general-purpose dual-beam oscillograph of moderate price, suitable for use in the research laboratory, and yet sufficiently compact and sturdy for production applications.

A bulletin describing the new Type 322 and giving complete specifications is available by writing the Instrument Division, Allen B. Du Mont Laboratories, Inc., 1500 Main Ave., Clifton, N. J.

Retaining Rings

The Grinnell Co., Providence, R. I., reports that the use of triangular self-locking Waldes Truarc retaining rings has enabled them to cut down on the use of scarce raw materials in their Thermolier unit heater.

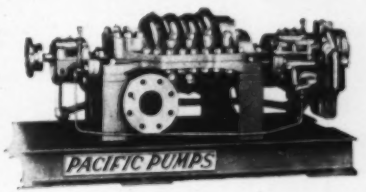


A threadded cast-iron tube rest which was formerly used to support a thermal tube tie rod at the bottom, and a jam nut at the top, have been replaced by a plain rod and two Waldes Truarc rings. Rings require no grooves, simply push into place, hold securely.

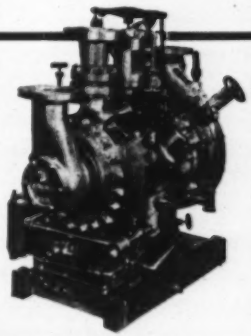
In addition to vital raw material conservation, labor time has been cut considerably in the assembly. These economies have resulted in a 52% cut in material and assembly costs.

Specify BOILER FEED PUMPS by Pacific
for small & medium sized boiler plants
to insure
Reliability . . . Durability . . .
Resistance to Corrosion-Erosion
Dependable Performance and the Highest Factor of Availability at All Times

THE Pacific
MULTI STAGE TYPE JBF
Capacities To — 1000 GPM
Discharge Pressures To — 1000 psi
Electric Motor Drive To 3600 RPM
Steam Turbine Drive To 5000 RPM
Speeds To — 10,000 RPM



THE Pacific
SINGLE STAGE-UNITIZED
STEAM TURBOPUMP
Capacities To — 500 GPM
Discharge Pressures to 1100 psi
STEAM To 900 psi Pressure — 850° F. TT
Exhaust Pressures To — 50 psi
Speeds To — 10,000 RPM



PACIFIC Precision Built PUMPS

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Offices in All Principal Cities
BF-15

THIS handsome indoor-outdoor "Twin-Temp" Thermometer, product of Seegers Manufacturing Company, tells at a glance the comparative temperature in your home and outside. Chace Thermostatic Bimetal is the actuating element for the upper "indoor" dial. A gas-filled bulb connected by a capillary tube to linkage behind the "outdoor" dial performs a similar function from a remote location on your window frame.

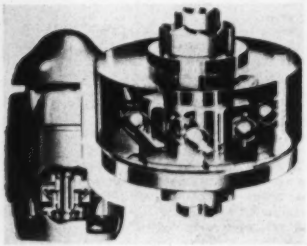
The thermostatic bimetal element is a precision-wound coil, the outer end of which is fixed to the mounting on the back of the dial. The shaft which carries the indicator is attached to the inner end of the coil. Changes in room temperature cause the element to react in a coiling or uncoiling motion, thus rotating the indicator to the correct temperature reading.

The accuracy of this simple type of thermometer is dependent upon precision manufacturing and assembly methods. Chace furnishes this element in finished coils fabricated from precision-rolled strip, coiled in a controlled-temperature department. We also provide our 29 types of thermostatic bimetal in elements to customer designs, in strips, random coiled lengths or welded or brazed sub-assemblies. Before you proceed with the design of an element for your new temperature actuated device, consult our Applications Engineers. For a complete reference on the design and selection of bimetal elements, write for our 64-page manual.

W. M. CHACE CO.
Thermostatic Bimetal
1619 BEARD AVE., DETROIT 9, MICH.

Ballomatic Backstop

When electric motor current ceases, a vertical turbine water pump back-spins unless means are provided to prevent motor reversal and avoid damage to pump bearings. A new method of preventing reversal of U. S. vertical hollowshaft motors has been developed by U. S. Electrical Motors Inc., of Los Angeles, Calif. By using balls, the geometric form most ideally suited to provide quick engagement and maximum strength, U. S. Ballomatic is a backstop that depends on natural laws to give quick-acting, dependable service. When the motor starts, centrifugal force throws the hardened steel balls out of engagement with the stationary member. When the motor stops, gravity pulls the balls down and one of them engages between the rotating member and the stationary ratchet, thus preventing reversal. The backstop is designed with a different number of balls and ratchet flutes which multiplies the possible number of locking positions in one rotation, thereby reducing impact and resultant wear to the minimum.



Hand Pyrometer

A new hand pyrometer with two scale ranges for the rapid and convenient measurement of surface, liquid, gas, and molten-metal temperatures has been announced by the General Electric Meter and Instrument Department.

Designated as the Type FH-1, the new pyrometer is especially useful where a temperature detector does not need to be installed permanently. Its two scale ranges are 0–500 F and 0–1500 F, and the change from one scale to the other is accomplished by the flick of a switch.

Three interchangeable tips available for the new pyrometer include a surface tip, an immersion tip for liquids and molten metals, and a two-prong contact tip. These tips, together with flexible and rigid extension arms, can be easily changed.

The automatic cold-junction compensation feature of the FH-1 eliminates the need for manual adjustment of the pointer for variations in temperature of the instrument or its surrounding atmosphere. Readings can be made directly from either scale of the instrument since no calculations or corrections are needed.

Typical applications include temperature checks of plastic molds, ovens, alloys with low melting points, and preheated metals for welding.

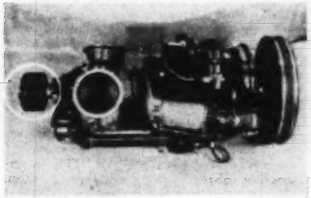
A bulletin, No. GEC-836, may be obtained from the General Electric Co., Schenectady 5, N. Y.

Keep Informed

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Shear-Type Rubber Coupling

A 16,000-lb Kenworth turbine-driven tractor, its 10,000 lb trailer, and a cargo of 42,000 lb has been driven over 15,000 miles of mountain roads with all the power delivered to the wheels through a shear-type flexible coupling made of rubber bonded to metal parts. This coupling is the result of the recommendations and subsequent production by Lord Mfg. Co., Erie, Pa.



The gas turbine which powers this truck is a development of the Boeing Airplane Co. of Seattle, Wash. It is a 2-shaft design which develops 175 hp. It has the unique characteristic of producing a straight-line rising torque curve with reducing speed. To obtain utmost driver comfort and to protect the turbine from excessive stresses which might arise from chassis frame twist or road shock, it was decided that the gas turbine itself should be flexibly mounted.

Rotating Digesters

Rotating digesters have been put to a new use, to turn cotton seed linters into pulp for rayon and plastics at the Memphis plant of the Buckeye Cotton Oil Co., a subsidiary of Procter and Gamble. The six vessels, similar to the type employed in pulp mills, were designed by The Babcock & Wilcox Co., New York, N. Y., especially for handling this product.

Each digester is designed to operate at a pressure of 165 psi at temperatures up to 350 F. They are cylindrical in shape, $32\frac{1}{2}$ ft long, with an 11-ft-ID, and an elliptical head. The charging nozzle, through which the cotton seeds and caustic are poured into the vessel, is 2 ft in diam and fitted with a portable cover. The pump discharge end of the vessel is a 90-deg included-angle cone. The cooked pulp is removed through a bottom blow nozzle 8 in. in diam.

To provide agitation and consequently a more uniform pulp, the digester rotates end over end at the rate of one revolution every four minutes. The rotation may be in either direction. The cotton seed linters in a caustic solution are "cooked" with steam as the vessel rotates.

The total weight of each vessel plus contents, 100 tons, is supported through two trunnions resting in heavy water-cooled bearings. The trunnions are 16 in. in diam., of forged steel, welded into a heavy center reinforcing section, according to a design exclusive with Babcock & Wilcox. The reinforcement, $4\frac{3}{4}$ in. thick, extending around the entire circumference of the digester, provides a means for distributing what would otherwise be highly concentrated stresses, over a large area of the vessel.

Steam is introduced, while the vessel is rotating, through one of the trunnions which terminates in a piping arrangement inside the digester.

"Hitch" Your CLARK Fork Trucks TO THESE Star* Attachments

Every CLARK fork-lift truck saves money—*—a lot* of money—for its user. Some save more than others because they are used more effectively — more efficiently — more regularly. They aren't allowed to stand idle "in between jobs." Demountable CLARK attachments enable them to do at great savings many jobs outside the popular concept of materials handling (snow plowing, coal shoveling and plant maintenance work, for example), and to do more and better jobs within that concept. Let CLARK help *you* make the most of and get the most from *your* fork-lift trucks. For your profit's sake, talk over your handling operations with the CLARK dealer nearest you—he's listed in the Yellow Pages of your telephone book.

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AND POWERED HAND TRUCKS · INDUSTRIAL TOWING TRACTORS

INDUSTRIAL TRUCK DIVISION • CLARK EQUIPMENT COMPANY • BATTLE CREEK 88, MICHIGAN
Please send: ☐ Basic Facts Book. ☐ Condensed Catalog ☐ Material Handling News ☐ Have Representative Call.
Name_____
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Your needs- OUR SPECIALTY

One of 4 Fermentors, 12'0" x 22'7" high tangent. 10% Stainless Clad, type 304 Stainless . . . manhole body and connections type 304 Stainless. Each fermentor equipped with coils of 3" O.D. x 14 ft. tubing . . . type 304 Stainless. Tested to 80# Hydrostatic . . . produced in accordance with case 896 of the A.S.M.E. Code.

CORRECT DESIGN, RIGHT MATERIALS...

. . . yes, DOWNINGTOWN's experience and research in the fabrication of various grades of Carbon Steel, Stainless Steels, Nickel-Clad, Stainless-Clad, Monel-Clad, Cupro-Nickel, Aluminum, etc., may be of help to you. We are equipped with the most modern facilities to handle complete jobs, within our limitations, in the correct alloys and methods of fabrication required to assure maximum operating efficiency.

DOWNINGTOWN also maintains a Heat Transfer Division under the direction and supervision of men thoroughly trained and experienced in this field. Our Engineering Consultation is at your service to aid you in preparation of plans and specifications for definite jobs.

Useful literature sent upon request on your business letterhead. Remember: "Your needs are our Specialty!"

DOWNINGTOWN IRON WORKS, INC.
DOWNINGTOWN, PA
STEEL & ALLOY PLATE FABRICATION
HEAT EXCHANGERS

NEW YORK OFFICE
30 CHURCH STREET

Keep Informed — NEW EQUIPMENT · BUSINESS NOTES · LATEST CATALOGS

All equipment was fabricated at the Barberton (Ohio) plant of The Babcock & Wilcox Co. and conforms with ASME Code requirements for unfired pressure vessels, including radiograph for welds and stress relieving. Material in the shells, heads and cones is ASME specification SA-212, Grade A, 65,000 tensile strength steel.

Plastic Pipe

The Timken Roller Bearing Co. recently employed rigid plastic pipe to solve a water problem at the firm's Columbus, Ohio, Branch.

Four deep wells—two supply and two return—provide water for several cooling processes in Timken's two Columbus plants. Each supply well is approximately 400 ft deep. Two multistage, centrifugal deep-well pumps force water through a 3000-ft network of factory pipe lines. Pumping capacity of the two systems is 650 gpm. This water is discharged into open cisterns before entering the return wells. The return wells, originally 400 ft deep, are located within 120 ft of supply wells. Warm water entering the return wells was finding its way into the supply and raising the temperature appreciably.

To overcome the above problem, the return wells were drilled to a depth of approximately 500 ft and tubed with Yardley 6-in. rigid plastic pipe to 475 ft, "packed off" at the 400-ft level. Hence, the warm return water now enters strata below the source of supply.

The deep-well pumps are suspended in the supply wells on the foot of 6-in. pipe "columns." Water in each column is under pump pressure, so that any leakage is from the inside to the outside of the pipe. These columns were formerly wrought iron, which is an easy prey to free H_2S (hydrogen sulphide gas) present in the water. Red brass columns have been installed as replacements, in the hope that they will outlast the wrought iron considerably.

Installation of the plastic pipe was speedy and economical. The job was accomplished with a small well rig, with winch, mounted on a $1^1/_2$-ton truck.

All plastic pipe and fittings were manufactured by the Yardley Plastics Co., Columbus, Ohio.

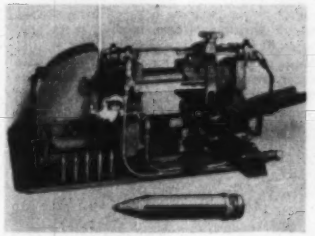
Keep Informed

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Air-Feed Marking Machine

The combining of a complete air-feed and ejector assembly with a motor-driven marking machine as a complete unit is announced by The Acromark Co., 345 Morrell St., Elizabeth, N. J. This machine is intended for the marking of cylindrical parts such as shells, cartridges, drills, pins, shafts, tubular parts, etc.

The parts can be brought to the machine by conveyer or by other means and rolled into feeding position down a gravity chute. At each stroke of the machine, an automatic air valve releases a plunger that pushes the part into exact marking position. Immediately succeeding the marking, another part is pushed to position, automatically ejecting the one that has just been marked.



This automatic operation increases production substantially, insures perfect marking, and permits the placing of this new marking machine on a continuous production line where a conveyer can carry the marked parts away and the only attention on the part of the operator need be guidance of the parts as they go into the gravity chute feed. This also can be made automatic for a continuous operation with little or no attention.

This machine itself, Model No. 9AMA, is of over-all size approximately 36 in. left to right × 24 in. deep × 16 in. high. The motor drive is a gear-reduction motor furnished for 110 to 220 volt 60 cycle a-c connection and the air pressure can be taken from a standard, medium to high-pressure line used in most shops.

Mica Mat

Mica mat, a new, paperlike material made of matted flakes of mica, is being used for ground insulation in the General Electric Company's Locomotive and Car Equipment Department, Schenectady, N. Y.

Developed in Europe, mica mat is manufactured by G.E. in a newly adapted process similar to papermaking. G-E engineers point out that the operation at Erie is one of the first American production uses of this type of ground insulation.

Mica mat is being used in both armature windings and field coils in the manufacture of some motors and generators for electric and Diesel-electric locomotives at Erie.

The new material will stand about 600 volts per mil of thickness, G-E engineers say. Its thickness is uniform within a fraction of a mil, and the thickness of a taped or wrapped conductor is now more constant than was possible with mica-glass cloth insulation. Engineers point out that mica mat also has fewer electrical "holes" than mica-glass cloth.

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ALL OVER THE COUNTRY
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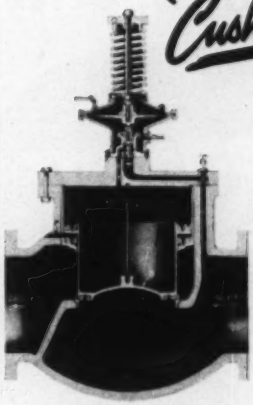
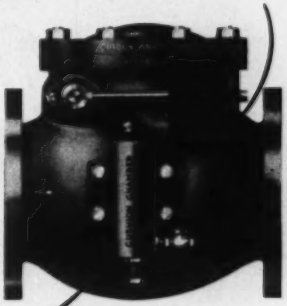
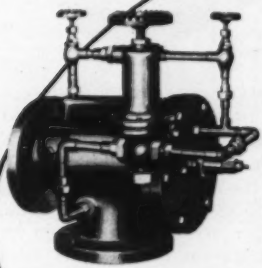


G-A ALTITUDE CONTROL VALVE



G-A SWING CHECK VALVE



G-A SURGE RELIEF VALVE

G-A WATER PRESSURE REDUCING VALVE

for DEPENDABLE, LOW COST OPERATION
in their water systems

These Golden-Anderson cushioned automatic valves are specifically designed for use in water works systems. Our experienced engineers will be glad to work with you on your pressure control problems. Write us today—no obligation.

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GOLDEN ANDERSON Valve Specialty Company

IMMEDIATE SHIPMENT FROM STOCK ON MANY SIZES.

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Engineered . . .

to permit greater load-speed capacity

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COUPLING
The Proven Gear-Type Coupling With Fully Crowned Teeth . . . A Major Improvement In Gearing.
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THIS FUNDAMENTAL IMPROVEMENT in gear tooth design practically eliminates all "end tooth and tip" contact and provides greater freedom of axial movement. This tooth design accomplishes tight fit on the crown as well as on the flanks. It is the first gear tooth on which all the load is carried on strong flanks rather than tooth edges. It reduces backlash to a minimum. These advantages, plus thrust compensation, and correction for angular and lateral misalignments give maximum relief from coupling failure grief.

Amerigear Couplings, made in several standard types, are available for standard shaft sizes and a wide range of speed and load capacities. Catalog of standard type Amerigear Couplings is available on request. Amerigear Power Transmission Engineers are available for consultation.

AMERICAN FLEXIBLE COUPLING COMPANY

Originator of the Amerigear Fully Crowned Tooth

Sales Offices in Principal Industrial Centers

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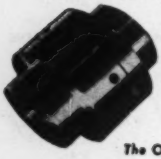

Write on your Business Letterhead for further information regarding *Amerigear Couplings* with the *Fully Crowned Teeth* and Catalog 501.

Also Manufacturers of
The Original "Oldham Type" American Flexible Coupling

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NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

The manufacture of the new material, G-E engineers explain, is done by baking mica at 700–800 C and then suddenly quenching it with cold water, causing the mica to explode into tiny flakes. The water-mica slurry is then fed into a papermaking machine and comes out as a dry, fragile paper. This paper is impregnated with a heat-resisting silicone varnish and applied to glass cloth for use as wrappers. Engineers add that the finished product meets the specifications of class "H" insulation.

Steel Roadway

A new-type steel roadway for loading areas, said to require little or no maintenance, is now being offered to industrial plants by the Irving Subway Grating Co., Long Island City, N. Y.

The roadway is open-mesh steel grating with a $3\frac{1}{2}$-in. spacing between bars, similar to the portable airfield landing mats produced by the company in World War II. It has been tested daily for the past four years under maximum truck-loading conditions at the Irving plant.

A section of the test loading area is on filled-in ground, unsuitable for concrete surfacing. The company suffered expensive loading delays in repairing road wash-outs and sinking after rains. Early in 1948, it was decided to put in a test steel roadway strip as the answer to this problem. Grating panels were laid over an area of 25 sq ft. The interstices were filled with sand and then surfaced with asphalt road oil as a binder.

The roadway today is as solid and efficient as the day it was laid. It has never been repaired and the ground has not sunk. The heaviest vehicles and loads can be sustained on the roadway grid, including cranes and tractors, according to Irving officials.

Corrosion In Action

A new, sound color film, prepared under the direction of the Corrosion Engineering Section of The International Nickel Co., and entitled "Corrosion in Action," shows how corrosion works to cause an annual loss in industry and elsewhere estimated at over $6 billion. It also shows how this damage can be avoided or controlled by various means, such as by the selection of corrosion-resistant materials, by the development of new alloys to meet given situations, by the use of electric currents to provide cathodic protection, and by other methods.

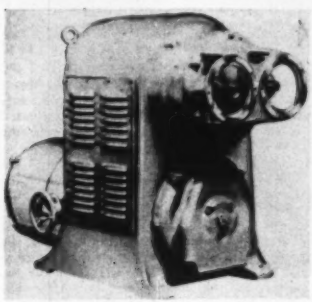
The film has been so produced that it can be shown in one part, in any combination of two parts, or in the full three-part length—depending on the time available. Each part requires 20 min showing time.

Almost every technique known to the motion-picture industry was used in the filming of the picture, including animated drawings, slow motion dissolves, and time elapse photography. In producing it, films were made at the big testing stations of the Kure Beach corrosion testing project, near Wilmington, N. C.; at the project's new laboratory at Harbor Island, N. C.; in industrial plants in various parts of the country; and elsewhere. The film took approximately a year to produce.

"Corrosion in Action" was made essentially for technical, educational and industrial groups, though its treatment is such that it can be understood by nontechnical audiences. It is available for use in schools, colleges, industrial plants, and before technical societies. Bookings can be made through the Corrosion Engineering Section, The International Nickel Company, Inc., 67 Wall St., New York 5, N. Y.

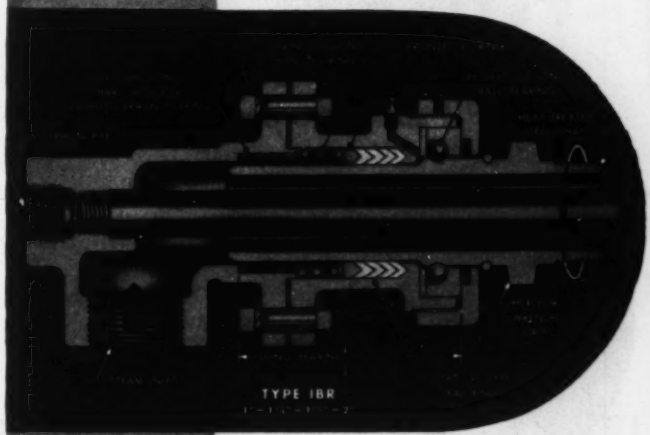
Dual-Head Test Stand

To determine the operating characteristic of component parts such as aircraft generators, vacuum pumps, alternators, magnetos, hydraulic pumps, and compressors, a test stand with a dual head has been developed by engineers of U. S. Electrical Motors, Inc. The dual head permits a wider variation than a single head in take-off speeds. It permits two component parts to be tested at one time. The U. S. Aero test stand consists of a variable-speed motor which can be instantly changed from speed to speed by merely turning a control dial. Brackets are mounted on the motor to accommodate various components to be tested. The horsepower for continuous duty is from 7½ to 50, and for intermittent duty from 10 to 75 hp. The ratio between the two take-off shafts is usually 2:1. Speeds and ratios may be changed to meet the user's particular requirements. For example, the unit designated as VEU-GSDT has a high-speed shaft with maximum of 10,800 rpm and minimum of 1950 rpm, while the low-speed shaft has a maximum of 5900 rpm and a minimum of 1070 rpm. The test stand can be supplied with a tachometer which will give direct rpm readings for both take-off shafts. Literature regarding the new U. S. dual-head test stand may be obtained from U. S. Electrical Motors Inc., 200 E. Slauson Ave., Los Angeles 54, Calif.



BARCO

Revolving JOINTS



Up to 50% power savings!

PRODUCT DESIGNERS and plant engineers throughout the country have been quick to recognize the ADVANTAGES offered by Barco's new *improved* Type IBR Revolving Joint for service on drum type dryers, coating rolls, calenders, mixing drums, clutches, chucks, chill rolls, sanforizers, and other rotating machinery:

- Free-Floating, Low Torque Installations.
- Up to 50% Power Savings.
- Better Temperature Control where steam is used for heating rolls.
- Low Maintenance; No Adjusting.
- Ability to Withstand Vibration and Hard Usage.
- All Parts Easily Accessible.

Barco builds a complete line of revolving joints for steam, water, air, oil, gas, and hydraulic service. Sizes from ¼" to 5". Pressures to 250 psi, steam, or 1000 psi, hydraulic. Speeds to 2500 rpm. *Barco Engineers are at your service; ask for recommendations.* BARCO MANUFACTURING CO., 1821F Winnemac Avenue, Chicago 40, Illinois. In Canada: The Holden Co., Ltd.

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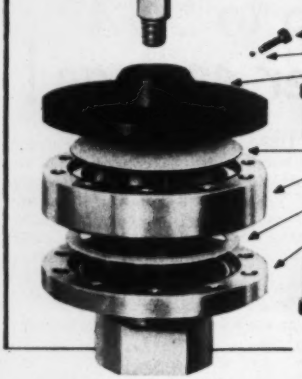
HELICOID Chemical Gage

The gage that retains its original accuracy longer, lasts longer, costs less per gage, per year

• For chemicals and liquids which would corrode or clog the Bourdon tube. Simple, sturdy construction proved in the field.

Pressures to 3000 p.s.i., vacuum, or compound; temperatures to 400° F. Diaphragm unit may be ordered separately.

FEATURES



Filling Screw
Sealing Ball
Upper Housing
Clamping Bolt
TEFLON Diaphragm
Cleanout Ring
TEFLON Gasket
Lower Housing

• The Helicoid movement is a simple cam and roller arrangement that gives long, trouble-free service. It has no gear teeth to wear out. Helicoid Gages are made in various sizes and shapes, with black, white, or phosphorescent dials. For wall or stem mounting. Helicoid Gages cost less in the long run.

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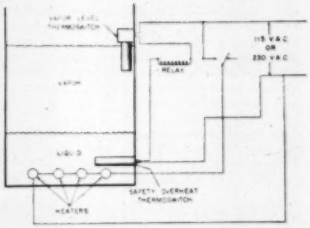
NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Thermoswitches

An ingenious arrangement of thermostatic controls enables a hot vapor degreaser to operate at highest efficiency while its heating elements are protected from destructive overheating. Two Thermoswitch units, precision thermostats manufactured by Fenwal Inc. of Ashland, Mass., maintain the vapor level at a safe height within the tank and prevent the heater elements from burning out.

Grease-coated or grimy materials, suspended in the degreasing tank, are effectively cleaned by the hot solvent vapors (trichloroethylene or perchloroethylene) generated by heating the reservoir of solvent at the bottom of the tank. The hot vapor, condensing on the surface of the material, washes off the grease or grime which then collects as sludge at the bottom of the tank. Two control problems arise in the operation of this open-top degreaser: preventing the heavier-than-air vapor from overflowing the top of the tank; and protecting the heater from burning out because of the insulating effects of the sludge accumulation.

To control the vapor level, a sensitive device capable of quick response is required. This response is provided by a normally closed Thermoswitch, as the diagram shows, inside the tank at the "danger" level. The



thermostat, which has a sensitivity of less than ±0.5 F and set to function at 170 F, "senses" the hot vapor rising to its level and quickly opens the heater circuit. The heater remains off until the vapor recedes to a safe level, whereupon the thermostat, activated by the drop in temperature, again puts the heater into operation.

The heater elements at the bottom of the tank are protected from overheating and possible destruction by the action of a second, normally closed Thermoswitch. This unit, set at 235 F, is installed adjacent to the heaters. Should the insulating action of the accumulated sludge cause the temperature to rise to 235 F, the thermostat cuts off the power to the heater circuit. After the temperature drops to a safe level, the thermostat again functions and puts the heater into operation. Thus, two Thermoswitch units, one operating in a liquid and the other in a vapor, combine to control and safeguard the operation of the degreaser.

Line-Type Purifier

A new low-cost line-type purifier, Type LC Hi-eF, has been announced by the V. D. Anderson Co. for smaller pipe lines from $\frac{1}{2}$ to 2 in. The low price of these units, according to the manufacturer, permits purifiers to be used for the first time for many installations formerly considered uneconomical.

A few of these applications are (1) to clean up steam processing lines to get better pro-

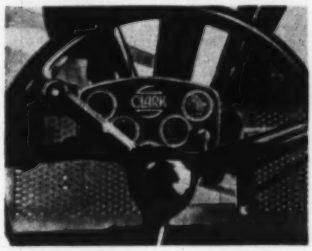
duction out of kettles, sterilizers, laundry equipment, vulcanizing machines, etc., (2) to protect small engines, turbines, and regulating equipment from pipe scale and other solids, (3) to remove entrainment from vapor lines following evaporation or distillation, (4) to purify steam for food processing lines, and (5) many other steam and air applications such as protecting rotating steam drums, steam ejectors, steam-jacketed kettles, air tools, spray painting, intercooler for gas compressor, etc.

This new purifier removes entrainment by means of an improved centrifugal element within the unit which engages and imparts a rapid rotational motion to entrainment-laden vapor, throwing the solids and water outward to the walls of the purifier. Each unit is warranted to remove more than 99% of the entrainment. Type LC Hi-eF purifier is installed like a valve or steam trap and is very compact. The 2-in. size is only 5 in. in diam and 17 in. long. Other features claimed by Anderson are no moving parts, eliminating maintenance, minimum pressure drop through the unit, lightweight construction, and large entrainment capacity. Designed for steam applications up to 400 psig and 500 F, the body is forged steel with stainless centrifugal elements.

For descriptive literature and prices write for bulletin No. 500 to Purifier Division, V. D. Anderson Co., 1935 West 96th St., Cleveland 2, Ohio.

Instrument Panel

According to a recent announcement by Clark Equipment Co., Battle Creek, Mich., all of its gas-powered Carloader and Clipper model fork trucks are now equipped with a newly designed instrument panel included as standard equipment. This panel is attached to the steering column directly in front of the driver insuring excellent visibility.



The panel includes fuel, temperature, and oil-pressure gages, ammeter, ignition switch, horn and Mico brake control fuses, and starter button. The Mico brake push button is located on the back side of the panel. Space is also provided for the installation of a Hobbs hour meter as extra equipment when required.

The dial instruments are set in a black enameled steel frame and are protected by thick glass faces. The entire assembly is encased in a sturdy metal box for complete protection. All connecting wires running from floorboard to panel box are housed in a steel channel attached to the mounting plate. In case of alteration or repair, the panel box may be easily opened or the entire mounting may be removed.

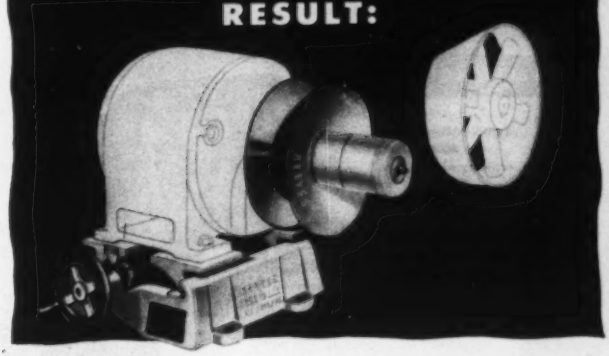
REEVES
Vari-Speed
Motor Pulley
Converts any standard, constant-speed motor to a Variable-Speed Drive

REEVES Motor Base provides sliding platform for motor. Handwheel or push-button control increases machine speed by moving motor toward driven machine, decreases speed by reverse movement.

Disc assembly mounts directly on motor shaft. This simple assembly consists of two cone-shaped discs and belt-tensioning spring.

V-belt connects disc assembly with driven machine.

RESULT:



● REEVES Vari-Speed Motor Pulley is the easiest, lowest-cost method of giving a constant-speed machine stepless speed adjustability. Eliminates all complicated electrical hook-ups, chain drives, gears, etc. . . . widens machine work range, increases rate of production and reduces production cost by providing the right speed for each operation under every changing condition—*without stopping the machine*. Send for complete information to Dept. ME6.

REEVES PULLEY COMPANY • COLUMBUS, INDIANA
Recognized leader in the specialized field of variable speed control
STEPLESS! ACCURATE! POSITIVE!
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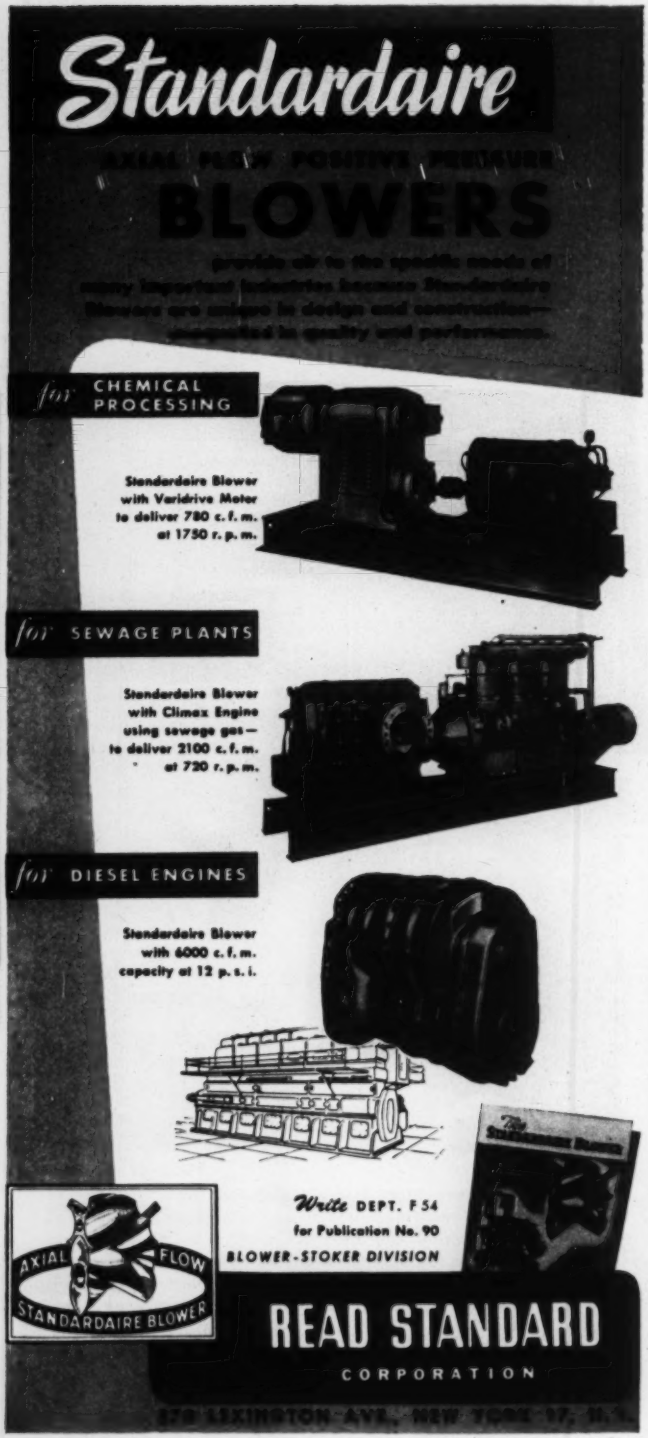
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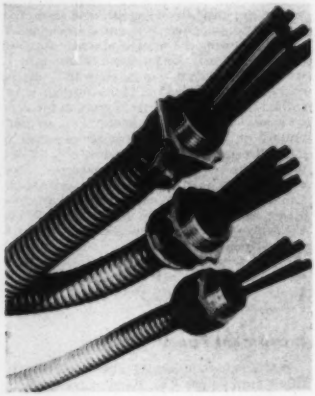
Armortube Cable

Pneumatic and hydraulic control circuits may now be streamlined through the use of Armortube cable, a flexible, protected multitube transmission line. This unique cable is made up of $\frac{1}{4}$-in-OD aluminum or copper tubing gathered in a slow continuous spiral similar to the construction of rope. A tube bundle is first wrapped in water-repellent insulating tape; then encased in heavy rust-resistant, galvanized steel strip like that used for BX electrical cable.



Armortube cable has been designed to: (1) cut installation time and costs; (2) save critical materials; (3) protect instrument and control connecting lines; (4) conserve space, and (5) improve plant appearance.

Available in bundles of 4, 8, and 12 tubes, the cable is capable of transmitting hydraulic control pressures as high as 3000 psig and all ranges of pneumatic control pressures. Connections and take-offs may be made in standard electrical junction boxes. Expensive support racks are eliminated. Standard pipe or conduit clips may be used to fasten Armortube cable to walls or ceilings. A tracer tube easily identifies corresponding tube ends between cable connecting points, since all tubes in a bundle maintain the same position relationship.

Armortube cable is a product of the Bailey Meter Co., 1022 Ivanhoe Road, Cleveland, Ohio. Complete specifications may be had by writing for bulletin No. BA-927.

Magnetic Amplifier

The new Magamp magnetic amplifier system recently developed by Westinghouse Electric Corp., Pittsburgh, Pa., will be used to control a new 66-in., 4-stand tandem cold-reduction mill being built for Pittsburgh Steel Co.

The Magamp will furnish excitation and regulate accurately the voltage of the generators supplying the mill and real motors. The voltages of the separate generators supplying the individual stand drive motors must be proportioned accurately during threading, acceleration, running, and deceleration, to avoid looping or breaking the strip between stands and to assure the smallest possible amount of off-gage strip.

Another unusual feature of this mill is that it will be the first installation with twin-motor drives on all stands. These motors will be connected through off-setting gears to the upper and lower mill work rolls so that the rolls are driven independently. With a twin-motor drive, off-setting gears are necessary since the two motors cannot be located to couple directly to the small-diameter work rolls.

In mills such as this, each succeeding stand must run faster than the preceding stand in inverse proportion to the decreasing strip thickness. With direct pinion drives, such as have been used on this type of mill, each succeeding stand motor must run at higher speed, and a different design motor is required for each stand.

By making the off-setting gears of different ratios, the motors can operate at the same speed and hence be of duplicate design. Thus, on this new mill, six duplicate 2250-hp motors will be used for the three 4500-hp twin-drives on stands No. 2, 3, and 4. Also, selection of the 200/450 rpm speed range for these motors, allows extensive interchangeability of the off-setting gear parts.

Electrical Connectors

Titeflex, Inc., Newark, N. J., announces the marketing of a complete line of new lightweight electrical connectors, originally developed by the Salsbury Corp., Los Angeles, Calif. Titeflex will now be the only company to manufacture and market this new-type connector. Designed to meet special requirements of temperature, corrosion, and vibration that no other standard connector could solve, it is now available for general use on all electrical equipment.

The Titeflex connector will be furnished in 17 shell sizes, conforming to AN sizes 8-36 inclusive and can be furnished for cord connections, shielded assemblies, and bulkhead or box mountings.

This new lightweight connector introduces an unusual method of assembly that allows for unlimited wiring arrangements. Its unique design eliminates clamps, saves space, facilitates harness assembly, and permits easy changes in wiring arrangements.

Room Air Conditioners

York Corp. of York, Pa., has announced that it has designed a $^1/_3$-hp and a 1-hp window-sill-type room air conditioner with a hermetically sealed refrigeration circuit for the 1952 air-conditioning market.

York has also refined five other room air conditioner models including the $^1/_2$-hp and $^2/_3$-hp window-sill-type units and the 1, $1^1/_2$, and 2-hp console types.

New

Up-to-date

Second

Edition

HANDBOOK OF ENGINEERING FUNDAMENTALS

Edited by OVID W. ESHBACH, *with 39 contributors*

Completely revised, enlarged by 10%, improved throughout—brings together the most important facts and principles of engineering in *many* fields. A new section on aerodynamics has been added and the section on law has been completely rewritten.

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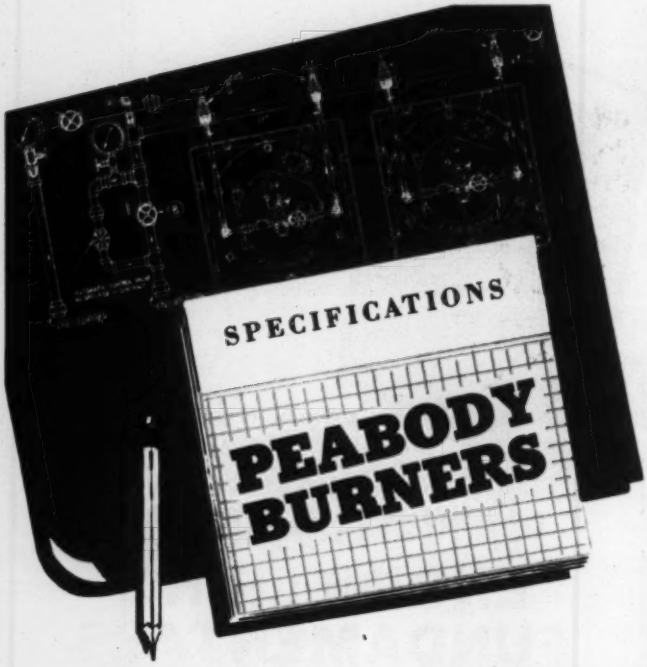

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The $^1/_2$-hp unit, known as Model 4, protrudes only 10 in. in the room. It is claimed to be the only $^1/_2$-hp air conditioner to have 4-way adjustable air distribution grilles, and features heavy-duty, disposable-type filters easily reached without having to remove the cabinet from its mountings.

The 1-hp conditioner, known as Model 51, was designed for handling large-size rooms. Draft-free circulation, one of the major features of the York units, is accomplished by means of easily adjustable rotary grilles. The far-corners of the room are reached with cooled air by means of the units' big multi-blade disk-type fan.

Machine Tool Lubrication

A preventative maintenance program is being used by The Timken Roller Bearing Co., of Canton, Ohio. The program includes mechanical inspection, electrical inspection, and lubrication. Last year systematic lubrication was inaugurated to strengthen the preventative maintenance project. The proper lubricant and the proper frequency of lubrication, and the testing and improving of new lubricants is the purpose of this project.

The lubricating schedule is accomplished in this manner: Plasticized lubrication cards are attached to each machine. Each card indicates the lubricants to be used in all parts of the machine. The frequency of lubrication, types of lubricants, and methods of procedure appear in a separate lubrication manual used by the Maintenance Department.

Since The Timken Roller Bearing Co. buys its lubricants in large quantities, they have found it economical to blend their own lubricants to gain those special qualities needed in oil for a particular job. For other conditions, special-purpose oils are purchased.

The object of this systematized lubrication program is obviously to decrease maintenance costs and lost time. Timken engineers say that it will be necessary to use the system for several years before concrete evidence can be obtained which will measure the system's value in dollars and cents.

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NEW EQUIPMENT
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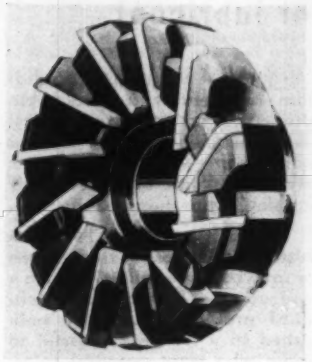
Milling Cutter

Kennametal Inc., Latrobe, Pa., has introduced an improved milling cutter, Style KF Kennamill, designed primarily for steel production milling runs where adequate horsepower is available, and where intermittent or narrow cuts are encountered. It is also well-suited for heavy cast-iron cutting.

The KF Kennamill has only four different parts: Body, blades, wedges, and nuts. Stud-type wedges and screws are one-piece high-alloy steel, hardened and ground to close tolerances. They remain assembled to the cutter body at all times, thus reducing the possibility of "lost" parts.



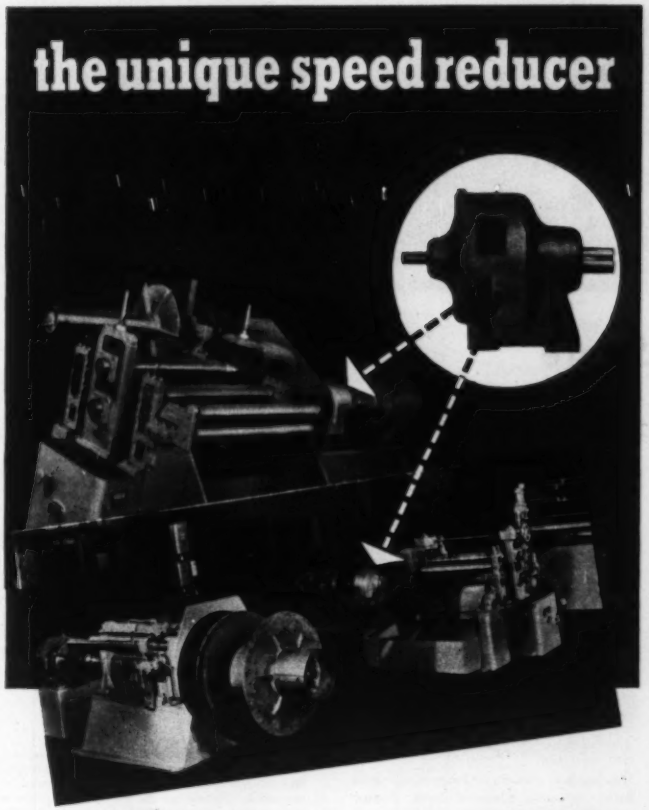
The blades are heavy, solid, wedged-in—no brazing strains. No hammers or special tools are needed to tighten them—a simple hex wrench is sufficient—breakage and wedge distortion are minimized.

Blades are interchangeable in all slots of any size of cutter body of the same type. Wedges are round and are interchangeable in any slot of any size cutter, either right or left-hand. They do not have to be pried out, but can be readily loosened with a soft hammer.

Other features of this cutter include: (*a*) mountable on any common spindle; (*b*) heavy construction and great rigidity; (*c*) ample wedge clamping area; (*d*) "freeze-proof" assembly—no threads in body to strip out; (*e*) adequate wedge width tolerance to allow for wear on the wedge and cutter body blade slot wall; (*f*) chip clearance room for heaviest cuts; (*g*) wedges can be pulled up without movement of blades; (*h*) blades are advanceable in direction of cut and can be set to precise tolerances.

The Style KF Kennamill is made in four cutting diameters: 6, 8, 10, and 12 in., either right or lefthand. Specifications and prices are available in Supplement 2 to Catalog 51, which can be obtained from the manufacturer.

GIVE
and give yourself



Coiled strip stock in *any* width . . . *when* you need it and at *lower cost!* That's what shops equipped with Yoder Rotary Slitters are assured. For with these dependable machines, the delays and higher costs of special width stock are eliminated. Mill-width coils (always more readily available) may be slit to requirements on a moment's notice.

In designing machines to fulfill such a key assignment, The Yoder Company must naturally exercise extreme caution in selecting so vital a component as a speed reducer. And it certainly does! No. 2, 2½ and 3 sizes (two are illustrated) are equipped with compact, horizontal, Winsmith (pat.) Differential Gear Reducers . . . *unique among speed reducers!*

The heart of this design is a 6-gear planetary element, free within its housing to float into the most equalized load distributing position. Even wear, automatic compensation and alignment, smooth, enduring operation are thus assured.

For requirements within the 1/100 to 85 hp range, with ratios from 1.1:1 to 50,000:1, Winsmith is the name most remembered. Information in "Save through Standardization" folder. Write.

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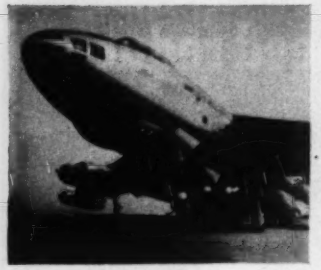

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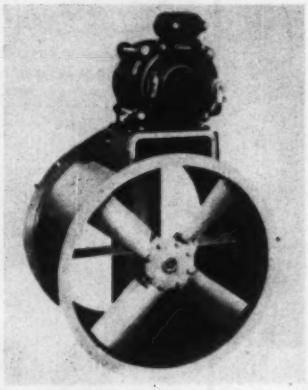
Booster Fan

A heavy-duty belt-driven fan, with motor outside of air stream, for use in paint spray booths, large range hood exhausters, or in ventilating or heating systems, is announced by Chelsea Fan & Blower Co., Inc., Plainfield, N. J. Recommended for air movement up to 350 F, this belt-driven fan is relatively quiet and will operate against moderate static pressure up to 2 in. Equipped with nonoverloading cast aluminum airfoil-type propellers, these units are completely ball bearing. Motors are semienclosed or explosionproof, as required. Hoods can be supplied for outside mounting. Units available in sizes from 16 to 36 in. and air deliveries from 2700 to 23,000 cfm. Catalog No. 400 or bulletin No. 405-A, give further data.



Air delivery ratings are determined by the standard test code of the Propeller Fan Manufacturers' Association and the American Society of Heating and Ventilating Engineers.

Document Copying System

An experimental photographic system for making quick, inexpensive copies of documents in less than a minute was developed at the Research Laboratories of the Eastman Kodak Co., Rochester, N. Y. The new method may eventually have wide application in business offices and other areas where a simple, speedy means of making a small number of accurate copies of an original document is desired.

It is emphasized that the system is still in the research development stage. As much as a year of testing and development work may still be necessary before it can be made available to the public.

The method involves use of paper, called a matrix, coated with a special photographic emulsion. The emulsion, although light sensitive, is slow enough so that it is not affected by ordinary room lighting during handling. When exposed with a document to a bright light source and placed in a special activating solution, a master image is quickly formed. This image is composed of soft photogelatin containing a dark dye.

When this master image is placed in contact with a sheet of plain white paper, a very thin layer of the dyed gelatin is transferred to

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the print paper. This positive copy of the original document is then ready for use.

The procedure is roughly as follows:

1 The document—for example, a letter, drawing, or page of manuscript—of the 8½ × 11-in. standard size used in most offices is placed in face-to-face contact with a sheet of matrix paper coated with the special emulsion.

2 The sandwich is then exposed through the back of the matrix paper for about 15 sec in a light box in the upper section of the copying unit. (This is known as the reflex copying method.)

3 The exposed matrix is then inserted into the activating solution through a slot in the front of the unit. Processing time is about 20 sec.

4 A sheet of plain white paper is inserted in another slot and both papers are pulled from the unit together. As they are removed a pair of rollers bring them into close contact.

5 The pages are separated immediately. The resulting copy contains a positive image of high permanence of the original document.

6 To make duplicate copies, the matrix is returned to the activating solution, a new sheet of print paper is inserted in the unit, and the pair are removed and separated in the same manner.

Concentrator

A unique new Carrier concentrator and blast freezing installation to produce frozen pineapple juice and other products for the Hawaiian Pineapple Co. was announced by Carrier Corp., Syracuse, N. Y.

Carrier officials said the new three-effect concentrator—now being installed at Honolulu, Hawaii—is the first high-vacuum low-temperature unit of its kind to be designed for Hawaiian pineapple juice. It incorporates a special essence recovery unit which will capture volatile aroma constituents for blending back into the concentrate to reproduce the exact taste and smell of fresh juice.

The concentrator will evaporate nearly 11,000 lb of water per hr from the juice, permitting production of some 200 six-ounce cans of blended concentrate per minute or better than a quarter of a million cans per day.

Cans of concentrate and packaged pineapple products will be frozen in a high-efficiency air blast tunnel of new design. Containers will travel through the tunnel on a wire mesh belt. A continuous blast of chilled air from a battery of 12 special Carrier cold diffusers will pass upward through the mesh against the bottoms and sides of the containers where the product is in direct contact, thus obtaining the greatest possible rate of heat transfer. Conventional freezing tunnels have used a downblast of air which is often insulated from the product by a layer of air at the top of the container.

Five Carrier ammonia compressors developing a total of 352 tons of refrigeration at suction temperatures ranging from +40 F to −47 F serve the concentrator, freezing tunnel, juice storage tanks, and cold storage warehouse.

Refrigeration for the concentrator is used to maintain evaporating temperatures and vacuums at the desired levels by means of a barometric condenser. Vapor from the juice in the third effect is recompressed by steam and piped to the first effect to supply heat for evaporation. The heating medium for the second and third effects is juice vapor from preceding effects.

Say goodbye to the costly servicing of sensitive equipment at destination — For one user Lord Shipping Mounts cut service and inspection time on overseas shipments from as many as 30 hours to only 4 hours.

Lord Shipping Mounts in your cases protect sensitive mechanisms in transit by cushioning the shocks of rough handling. This protection prevents maladjustment, greatly reducing costly servicing at destination.

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Lightweight Soldering Iron

A new standard-voltage, lightweight, soldering iron, designed for pinpoint, high-speed soldering in close quarters, has been announced by the Industrial Heating Dept. of the General Electric Co., Schenectady, N. Y.

Expected to have wide application by radio, electronic, and instrument manufacturers, the new iron features a long-lasting, iron-clad, corrosion-resistant working surface which, according to G-E engineers, will bring about a reduction of maintenance costs and production-line stoppages due to frequent changing of tips.

The small slender iron, which is $10^1/_2$ in. long, has a $^3/_{16}$-in. shank and a $^1/_4$-in. tip. The iron is heated by a G-E Calrod heater which protrudes into the tip, thus giving it an efficient heat transfer. This high-heat efficiency, said the engineers, results in a quick heat-up and rapid recovery for the new iron in operation. It weighs $8^1/_2$ oz and is rated at 60 watts, 120 volts.

With all parts readily interchangeable for rapid repair, the iron's tip and heater assembly are easily assembled and disassembled from the handle. In addition, the iron is equipped with a flanged plastic handle, so that it may be laid down temporarily without need for a stand.

The engineers pointed out that the iron's lightweight will reduce operator fatigue, thus resulting in better production, increased efficiency, and fewer rejects than could be expected with heavier, more cumbersome equipment.

The iron, they said, is designed to stay ahead of the fastest industrial production lines, and to keep up with the fastest operators.

Permeable Base Stripping Film

A new experimental film which is expected to aid considerably the work of researchers working with autoradiography has been announced by the Eastman Kodak Co., Rochester, N. Y.

Developed by the Kodak Research Laboratories, the name of the new product is Kodak autoradiographic permeable base stripping film (experimental). The film gains its name from the fact that when the emulsion is stripped from its temporary film support, the backing of the emulsion is gelatin rather than a cellulose ester. This gives researchers a definite advantage since the gelatin backing can be penetrated by the developing solutions. As a result, the emulsion can be processed through the back while the emulsion surface is in contact with the radioactive specimen.

Stripping films as a group are most frequently used in the field of graphic arts where film is most easily used in the camera but some firm support—such as a glass plate—is desirable for the final operations. In this work—as well as in other fields—the ability of stripping films to be cut and fitted together in almost any shape or combination to produce any desired effect is extremely helpful. This same flexibility and adaptability is expected to prove definitely useful in the research field.

The thickness of the emulsion on the new experimental film will be approximately 5 microns. The thickness of the gelatin base will also approximate 5 microns. The sensitivity of the emulsion is between the sensitivities of Kodak nuclear track emulsions Types NTA and NTB.

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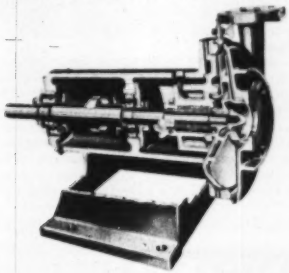
Chemical Process Pump

For pumping most all process liquids, either hot or cold, in moderate capacities against low, medium, or high heads, with special emphasis on corrosive and abrasive liquids with solids in suspension up to 5% by volume, Peerless Pump Division, Food Machinery and Chemical Corporation, has recently introduced a new chemical process pump designated as its Type DS.

This pump is available in discharge sizes from 1 in. through 6 in. providing a range for most all chemical process applications. Enclosed or open impeller design is optional construction. Using the enclosed impeller, see illustration, capacities up to 600 gpm are provided; using the open impeller offers a capacity range up to 1000 gpm. The Type DS will operate against heads to 231 ft. Driver is standard, horizontal, electrical motor mounted on common base with pump.



The Type DS is offered in both grease-lubricated and oil-lubricated designs.

The Type DS chemical process pump is completely described and illustrated in a new bulletin No. B-1600, available from Peerless Pump Division, Food Machinery and Chemical Corp., 301 West Ave. 26, Los Angeles 31, Calif.

Better Quality Nylon Tricot

A new beam let-off drive is producing a much higher quality of knitted nylon cloth for a well-known operator of tricot machines. This is the result of consistently maintaining proper runner lengths and having the warp supplied to the knitting elements at a constant linear speed. Fabric shading has been virtually eliminated.

These drives, Westinghouse Type BD, electronically control warp let-off such that the zero or mean position of the tension bar remains fixed. An increase in warp tension causes a change in position of the knitting machine tension bar. This change in position is converted to an electrical impulse which, when amplified, operates a small a-c motor geared to the beam. Operation of this motor releases the beam, maintaining proper tension.

A high gear ratio is provided between the motor and the beam so that, when the beam is nearly empty and the knitting machine is operating at normal speed, the beam motor runs at approximately 1400 rpm, depending upon the runner lengths desired. A worm gear drive is used so that tension on the warp cannot exert a driving force on the motor. The motor merely acts to release this tension by driving the worm gear at a speed such that the unwinding of the warp due to the tension exerted on it by the threads is just enough to maintain proper warp tension (constant aver-

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For further information on any of the boilers listed write for free catalogs or contact your nearest Bigelow representative.

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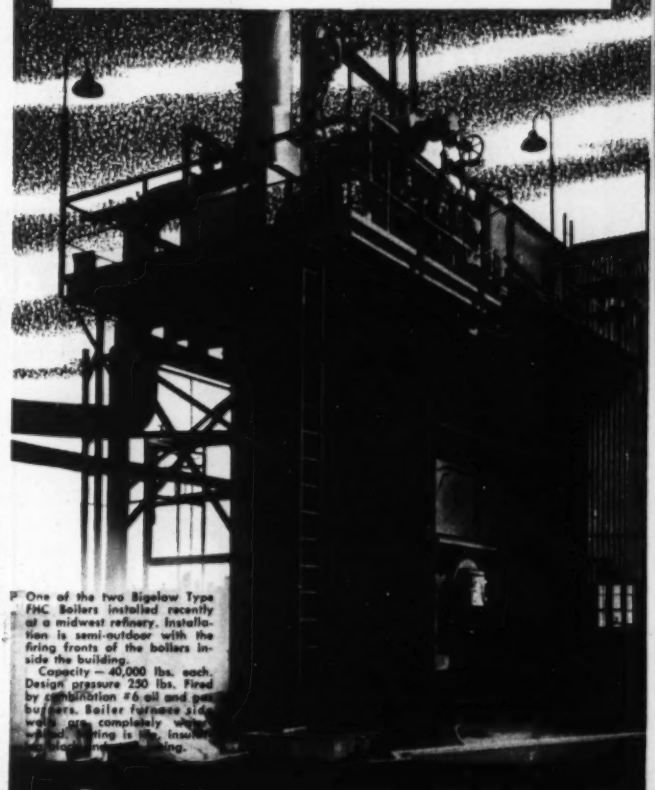

One of the two Bigelow Type FHC Boilers installed recently at a midwest refinery. Installation is semi-outdoor with the firing fronts of the boilers inside the building.

Capacity — 40,000 lbs. each. Design pressure 250 lbs. Fired by combination #6 oil and gas burners. Boiler furnace side walls are completely water-walled. Setting is tile, insulated block and [illegible]ing.

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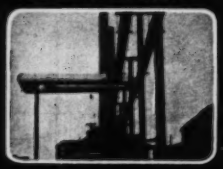

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UNDERGROUND OR OVERHEAD

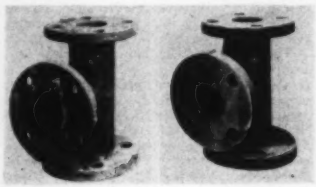
age deflection of the tension bar springs. Since the drive operates as a function of tension rather than speed, a change in beam diameter is automatically compensated for.

As tension momentarily changes through the action of the knitting machine, a dancer contact on the tension bar opens and closes. This contact, connected to the low-energy grid of a single thyratron tube, triggers the power circuit of the beam motor. The fluttering action of the tension contacts gives rapid on-off control of the motor voltage. Thus, the motor operates at a speed to maintain proper tension.

When it is necessary to stop the knitting machine for any reason, a fast-acting dynamic braking system provides extremely rapid stopping, which in conjunction with fast acting Westinghouse dynamic braking on the main knitting machine motor, keeps cloth stop marks at a minimum. A pulse of d-c current is forced through the motor windings, stopping the motor in one or two revolutions.

Rust Cleaning

A new chemical treatment that removes rust, tarnish, and light oil, chemically prepares metals for paint, and retards corrosion, is announced by Octagon Process Inc., 15 Bank St., Staten Island 1, N. Y. Known as Rustclean, the new compound destroys rust and rust-promoting surface contaminants, thereby retarding corrosion. Rustclean not only chemically cleans the surface of steel, iron, aluminum, zinc, and cadmium, it also forms a phosphate coating which acts as a base for organic finishes. Rustclean is also an effective tarnish remover for copper and its alloys.



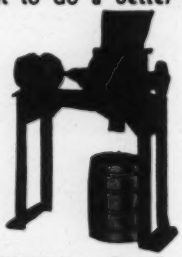
Several types of Rustclean are available, each designed for different work. The two standard types are Rustclean 12 and Rustclean 15.

Rustclean 12 is designed for a wipe-on process for large parts or in plants whose equipment or production is limited. The best method of applying this compound is by sponge or brush. The concentrate Rustclean 12 is diluted with water; the amount of dilution is determined by the condition of the metal.

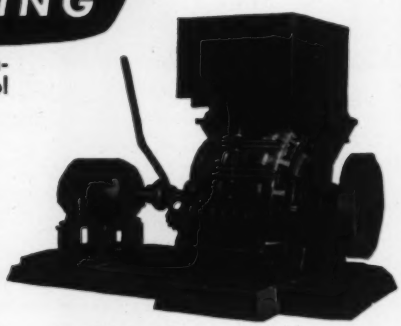
Rustclean 15 is a more concentrated com-

from TEST GRINDING
to TONNAGE
CRUSHING

AMERICANS are custom-built to do a *better* job!



AMERICAN Laboratory Size Mills
With the same reduction action as Metal Turnings Crushers (or hammer action)—American Laboratory Size Mills offer an efficient means for reducing razor blades, pewter castings and fragile, thin brittle steel to a reclaim product.



AMERICAN Metal Turnings Crushers
Bulky, hard-to-handle turnings are rapidly reduced as much as 80%, with this efficient, economical crusher. And the yield of cutting oil is increased 30 to 50 gallons per ton—proof of how profitable the installation of an American Metal Turnings Crusher can be for those who handle 20 tons or more of metal turnings a month.

There's a custom-built AMERICAN for your operation — write for further data and specifications.

American PULVERIZER COMPANY
Originators and Manufacturers of Ring Crushers and Pulverizers
1541 MACKLIND AVE.
ST. LOUIS 10, MO.

pound which is used in an immersion process in a stainless-steel vessel (recommended for use at elevated temperatures) or tank lined with rubber, polyethylene, or asphalt. It is most effective when used at a temperature above 160 F. Rustclean 15 is diluted with water and the amount of dilution is directly related to the degree of corrosion. Standard procedure for cleaning dirty, heavily oiled, rusty parts is to preclean with Octagon 400 (an alkali cleaner), rinse, Rustclean, and rinse again.

Cleaning of scale and rust is shown in the accompanying illustration by pipe Tee, shown at left before treatment. At right, same unit, after Rustcleaning, is completely free of rust and scale, and has a corrosion-resistant phosphate surface.

Business Notes

Correction

The February, 1952, issue of MECHANICAL ENGINEERING, announced the current expansion plans of Whitney Chain Co., as being in Boston, Mass. Actually, the factory, to which a new building is being added, is located in Hartford, Conn.

Lamson Establishes Two Engineering Scholarships

Starting with the school year September, 1952, two Lamson scholarships in Mechanical or Administrative Engineering will be established—one at Stevens Institute of Technology, Hoboken, N. J., and one at Syracuse University, Syracuse, N. Y. These scholarships are offered primarily to encourage talented children, grandchildren, and other relatives of Lamson employees to study in the field of mechanical engineering and material handling.

The scholarships will be for four years on a year-to-year renewal basis, contingent upon satisfactory performance. They will provide: full tuition, all fees, the cost of books and regular equipment, but will not include living expenses. Thus, for the four years, they will be worth approximately $4000 to the recipient. In addition, summer employment, if at all possible, will be provided for the student by the company. While the students may ultimately be employed by Lamson after graduation, there will be no obligation on the part of either the company or the student in this regard.

All candidates must meet the entrance requirements of either of the institutions they may choose. Final awards will be made by the scholarship committees of the institutions, who will consider previous scholastic records; general scholastic aptitude; character; qualities of leadership; and potentialities for success in engineering work.

Potential candidates, who will have graduated from an accredited high school or its equivalent by June, 1952, should write to: Lamson Scholarships, Lamson Corp., Syracuse 1, N. Y., for further information.

Use a CLASSIFIED ADVERTISEMENT
For QUICK RESULTS

New Metal Refinery In B. C. To Be Built By Kennametal

Macro (Exploration Div. of Kennametal Inc.) with main plant at Latrobe, Pa., will build an ore-dressing and electric smelting works on Kingsway at Port Coquitlam on a 20-acre site. The raw material, tungsten ores, and concentrates will be obtained to the extent possible from British Columbia sources. Scheelite, hubnerite, and wolframite ores and concentrates will be purchased for refining into tungsten carbide.

The main ingredient of Kennametal, the very hard tool material used in mining tools, metal-cutting tools, and wear-resisting articles, is tungsten carbide. Another ingredient in lesser amounts is titanium carbide which is refined from rutile, a mineral consisting of titanium dioxide. An affiliated company, Kennametal of Canada Limited has been operating in B.C. since 1940. Heretofore the raw material has been obtained from Kennametal Inc. at Latrobe, Pa., where the refining was done from ores and concentrates from all over the world. Kennametal Inc., operates the Nevada Scheelite Co., employing 70 men in mining and milling tungsten near Rawhide, Nev.

G.E. Expands Aviation Equipment Business

The General Electric Co. has announced the expansion of its aviation equipment business to include a new operation for the design, manufacture, and sale of turbine-driven accessories for jet engines and aircraft.

Included among the products which are now being produced or developed by the Accessory Turbine business are turbosuperchargers and impellers, jet-engine starters, turbine-driven fuel pumps, and air-turbine drives for alternators and hydraulic pumps. Headquarters for commercial, engineering, and manufacturing activities are at the company's River Works Plant, Lynn, Mass.

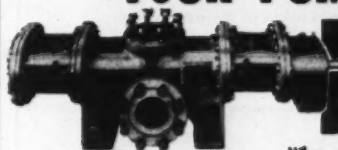
Rust-Oleum Corp. Appoints New Distributors

The Rust-Oleum Corp., Evanston, Ill., manufacturers of rust-preventatives, recently announced the appointment of The Republic Supply Co., 2600 South Eastland Ave., Los Angeles, Calif., as a new distributor for Rust-Oleum rust-preventive products.

Buhl Sons, located at the Foot of Adair Street in Detroit, Mich., also has been appointed as a new Rust-Oleum Distributor.

The following new distributor firms were also appointed: Adkins Co., Baltimore Ave., Berlin, Md.; Mill and Contractors Supply Co., 121–3 Water Street, Wilmington, N. C.; Warren Hardware Co., 183 West Market St., Warren, Ohio; American Radiator and Standard Supply Corp., 130 North 3rd St., Zanesville, Ohio; and Couch and Heyle, 1016 South Adams St., Peoria, Ill.

DOUBLE THE VALUE OF YOUR PUMP DOLLARS!



Specify *Sier-Bath* SCREW PUMPS

● Pump Shown: new External Gear & Bearing Bracket Type for non-lubricating fluids, semi-fluids. Capacities 1-700 GPM; Discharge 1000 PSI for viscous liquids, 500 PSI for water.

When you choose a Sier-Bath Screw Pump your total investment is about the same—but you get a pump worth *twice as much*:

Investment "A"	TYPICAL CHOICE	*Investment "B"*
Cam, Lobe, Vane or Gear Pump.....	$ 770.00	Sier-Bath Screw Pump.....	$1570.00
Low Speed Motor (or high speed motor plus reduction gearing).....	2580.00	High Speed Motor.....	1860.00
TOTAL.....	$3350.00	TOTAL.....	$3430.00

Sier-Bath Screw Pumps are more dependable, need less maintenance, and last longer than the types listed in "A". Because their *axial flow* allows low liquid velocities with higher RPM, they use less expensive (and easier to get) high speed motors. As these motors provide service equal to that of low speed motors—and as Sier-Bath Screw Pumps provide *superior* service—"B" is the right choice.

For further information, see your local Sier-Bath Representative, or write to

Sier-Bath GEAR and PUMP CO., Inc.
9256 HUDSON BLVD., NORTH BERGEN, N. J.

Also Manufacturers of Gearex Pumps, Precision Gears and Flexible Gear Couplings

Just Published

1951 API-ASME CODE

Unfired Pressure Vessels for Petroleum Liquids and Gases

This 1951 Edition applies to the design and construction of unfired pressure vessels subject to external pressures and to fusion-welded, riveted and integrally forged vessels. Provisions are included for periodic inspection, repair and allowable working pressures for vessels in service; materials to be used in construction are specified; suggestions are given regarding internal structures, corrosion allowance, protective linings, installation of pressure vessels, and design of supports; examples of computations are presented, also data and information useful to designers and inspectors

The Revision was made by a widely representative committee under the sponsorship of the American Petroleum Institute and The American Society of Mechanical Engineers. In its preparation cognizance was taken of the advances in the field and changes in industrial practices since the publication of the 1943 Code by amplifying and modifying many of the existing rules, and introducing new material, such as: the details for minimum welding required around opening attachments, the acceptance criteria for pressure relief devices, recommendations pertaining to the use of materials classified as "New", more accurate shell and head design formulas, and the adoption of rules in the ASME Code to provide for high alloy and clad or lined vessels of the several types used.

Published, April 1952, 285 pages, 5¼ x 7¾ in size

$3.00 ($2.40 to ASME members purchasing one copy; $3.00 each for additional copies)

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS
29 West 39th Street, New York 18, N. Y.

Keep Informed

NEW EQUIPMENT
BUSINESS
NOTES
LATEST CATALOGS

Wheeler-Economy Adds to Plant

On Feb. 25, 1952, C. H. Wheeler Mfg. Co. broke ground for a $600,000 addition to their plant in Philadelphia, Pa. The new building will be equipped with 30-ton cranes and will be 300 ft long.

A considerable number of new machine tools are being purchased so as to make the Philadelphia plant capable of handling an increased volume of condenser, pump, and naval deck machinery production.

The Wheeler Company has about a two-year backlog of orders, a large part of which is directly a part of the defense program. The balance of the backlog consists of steam-power plant equipment.

A new centrifugal pump test laboratory is being provided with a 400,000-gal pit with venturis, weirs, and dynamometers, for testing pumps up to 110,000 gpm.

Clark Bros. Forms New Corporation

The formation of a new corporation, Clark Bros. Pan American, Inc., has been announced. The new organization will act as the export corporation in Mexico and South America for Clark Bros. Co., Inc., Olean, N. Y., and will sell the engine and compressor products manufactured by that company, exclusively.

In addition to all sales activity, the new corporation will also handle all service and warehouse facilities in South America. The purpose of the move is to better serve the users of Clark compressors in South America. No change is contemplated in the sales and office personnel now serving the South American petroleum, gas, and industrial fields.

In addition to its home office which will be located on North Fifth Street, Olean, N. Y., and a New York City office in Room 800 of the Chanin Building, offices will be maintained, in Mexico City, Mexico and in the following South American cities: Caracas, Venezuela; Buenos Aires, Argentina; Bogota, Colombia; Lima, Peru; and Rio de Janeiro, Brazil.

Westinghouse Steam-Turbine Production to Set New High

The Steam Division of the Westinghouse Electric Corp. at South Philadelphia, Pa., will produce during 1952 the greatest volume of steam turbines in its history to help supply vitally needed electric power for the nation's defense effort. Steam-turbine generators produce nearly two thirds of all the electric power generated in the United States.

The division expects to ship 3 million kw of turbine capacity. This is nearly 100 per cent above last year's record-breaking figure, and four times the company's best prewar steam-turbine production.

The figures quoted for shipments from the Westinghouse plant in 1952 include industrial turbines—ranging in size from 200 to 7500 hp—that supply mechanical drives in the paper, oil, chemical, and other industries.

Prior to World War II, the Steam Division normally employed 3000 people. Since the war, the Division has spent several million dollars on enlargement and rearrangement of the plant which has correspondingly increased the number of employees to approximately 6000. Total annual payroll in 1951 reached $29 million.

Keep Informed | New Equipment | Business Notes | Latest Catalogs

Niagara Opens New Sales Office

Niagara Machine and Tool Works, Buffalo, N. Y., manufacturers of presses, shears, and other sheetmetal working machines and tools announces the opening of a Philadelphia district sales office in suburban Philadelphia at 50 East Wynnewood Road, Wynnewood, Pa.

ALCOA Expands Point Comfort Works

The first expansion unit of Texas' booming aluminum industry recently began operating to meet the growing needs of America's national defense program. With the flick of a switch at the Point Comfort Works of Aluminum Co. of America, Port Lavaca, Texas, the first of two new smelting lines went into operation at the plant.

The new line increases Point Comfort's production capacity to about 135 million lb of aluminum annually, and constitutes a major step toward alleviating the national aluminum shortage.

By terms of a contract signed last fall by Alcoa and the General Services Administration, the U. S. Government will get first call for five years on the output of the two new Point Comfort units.

The second new line is scheduled for completion within three months.

New Timken-Detroit Plant Starts Production

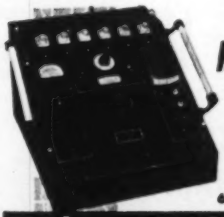
The Timken-Detroit Axle Company's new Ohio Axle & Gear Division has started production of axles and transfer cases for military trucks.

The new plant, located at Newark, Ohio, is an important link in Timken-Detroit's widespread chain of decentralized manufacturing facilities.

Occupying nearly 400,000 sq ft of floor space in a modern, single-story building of saw-tooth construction, the factory will constitute a completely integrated manufacturing unit for machining, heat-treating, and assembly operations with a well-equipped metallurgical laboratory.

Location of the plant is in keeping with a basic program of The Timken-Detroit Axle Co., which closely follows recommendations of the National Security Resources Board regarding dispersal of manufacturing facilities. The Newark, Ohio, site was chosen because of its strategic location in respect to raw-material sources and also because of good labor markets.

At full capacity, approximately 1600 persons will be employed. The entire output will be for defense, particularly units for the all-important military "six-by-six" all-wheel drive trucks.



Measure and Record Strain with PRECISION

6-channel unit

The Hathaway TYPE RS-10 PRECISION STRAIN INDICATOR

6, 12, 25 or 50 Channels

For Precision Measurements of Static Strain

Static strain in 1 to 50 channels can be measured in rapid succession. Individually-calibrated 21-inch dial provides an accuracy of ¼ percent. Smooth and accurate balancing controls for each channel. Continuously-variable gage-factor adjustment.

For Recording Dynamic Strain

The RS-10 can be used with an oscillograph (such as the Hathaway type S14-C) for recording dynamic strain, providing accurate balancing and means for precision calibration of the records.

MULTI-CHANNEL PRECISION MEASUREMENTS OF STATIC STRAIN
DYNAMIC STRAIN RECORDING TO 300 CPS WITHOUT AMPLIFIERS

Write for Catalog Sheet 3-H-4-N for details.

WRITE FOR YOUR FREE COPY OF HATHAWAY ENGINEERING NEWS

Hathaway INSTRUMENT COMPANY
1315 SO. CLARKSON STREET • DENVER 10, COLORADO

WORKS WHERE OTHERS WON'T

accurately formed

GRAPHALLOY OILLESS BEARINGS

SPECIFY GRAPHALLOY WITH CONFIDENCE

SELF-LUBRICATING ● EXTREMELY DURABLE ● CONSTANT CO-EFFICIENT OF FRICTION ● OPERATES DRY — OR SUBMERGED IN WATER, GASOLINE OR CORROSIVE LIQUIDS ● APPLICABLE OVER A WIDE TEMPERATURE RANGE — even where oil solidifies or carbonizes ● EXCELLENT AS A CURRENT-CARRYING BEARING.

GRAPHITE METALLIZING CORPORATION
1058 NEPPERHAN AVENUE YONKERS 3, NEW YORK

THOMAS Flexible ALL METAL COUPLINGS

FOR POWER TRANSMISSION REQUIRE NO MAINTENANCE

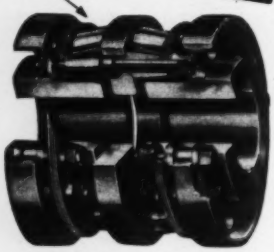
Patented Flexible Disc Rings of special steel transmit the power and provide for misalignment and end float.

Thomas Couplings have a wide range of speeds, horsepower and shaft sizes:
½ to 40,000 HP
1 to 30,000 RPM

Specialists on Couplings for more than 30 years

BACKLASH FRICTION WEAR and CROSS-PULL are eliminated
Lubrication is not required!

PATENTED FLEXIBLE DISCS



THE THOMAS PRINCIPLE GUARANTEES PERFECT BALANCE UNDER ALL CONDITIONS OF MISALIGNMENT.

NO MAINTENANCE PROBLEMS.

ALL PARTS ARE SOLIDLY BOLTED TOGETHER.

Write for the latest reprint of our Engineering Catalog.

THOMAS FLEXIBLE COUPLING CO.
WARREN, PENNSYLVANIA

Keep Informed | *New Equipment* | *Business Notes* | *Latest Catalogs*

Titeflex Establishes Electronics Division

Titeflex, Inc. of Newark, N. J., manufacturers of flexible metal tubing and aircraft ignition harnesses, announces the establishment of an Electronics Division to co-ordinate the manufacture and sale of flexible and rigid waveguides, electronic parts, and special equipment, due to the increased demand for this specialized equipment. During World War II, the company pioneered in the development of flexible waveguides, marketed as "Waveflex"—a precision made rectangular tube used for the transmission of high-frequency electrical waves by radar and microwave relay systems. The latter system has made coast-to-coast television broadcasting possible. The division will remain under over-all direction of Titeflex sales management.

Worthington Changes Name To Worhington Corp.

Worthington Pump and Machinery Corp. of Harrison, N. J., recently announced that the company's name has been changed to Worthington Corp. The Company has extended its manufacturing activities into many other fields with the result that today, with few exceptions, every industrial and commercial enterprise is a potential user of one or more of the many other items of its equipment. Because of the company's wide diversification it was believed that the continued reference to "pumps" in the Corporate name tended to lead the public into the erroneous conclusion that pump manufacture was the only endeavor. Such, of course, is not the case, since a major portion of its sales volume is in such varied products as air and gas compressors, Diesel and gas engines, air conditioning and refrigeration equipment, steam power generation apparatus, electric motors, generators, and switchgear, V-Belt transmission drives, construction equipment, and liquid meters.

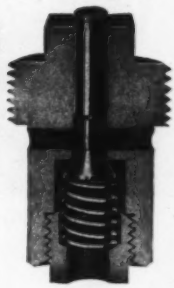
Rockwell Acquires New Companies

The Rockwell Mfg. Co., Pittsburgh, Pa., has announced the acquisition of the Deluxe Saw & Tool Co. and the Karbide King Tool Corp. The newest members of the Rockwell family of companies started in business in 1945 and operate plants in Chicago, Ill., and High Point, N. C. Beyond the new product functions of these plants they house extensive service facilities.

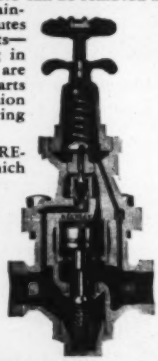
The Deluxe Saw & Tool Co. pioneered the manufacture of tungsten carbide-tipped circular saws for industrial application. The popular acceptance of this new-type saw guarantees longer service, more accurate cuts and smoother finishes on wood, plastic, hardboards, fibers, and metals.

UNIT PILOT VALVE

MAKES KECKLEY REGULATORS EASIER TO SERVICE AND MAINTAIN



Here is a unique Keckley feature that means extra convenience and savings for you. The pilot valve can be removed as a unit. This means easy inspection, maintenance or replacement in a few minutes time. No bother with separate parts—comes out as easily as the spark plug in your car. All other parts of this valve are readily accessible too! All wearing parts are made of tough, long wearing, corrosion resistant stainless steel, further lowering upkeep.



Check into the Keckley line of PRECISION PRESSURE REGULATORS which feature accurate, dependable control and easier, lower maintenance. Sizes from ¼" to 6"—Pressures to 300 lbs. steam, 600 lbs. air reduced to a low of 1 lb. Illustrated valve also available with various combinations for pressure and temperature control. Ask our representative, your industrial distributor or write us for further information.

SEND FOR COPY OF COMPLETE CATALOG 51-D

O. C. KECKLEY COMPANY
400 W. MADISON STREET CHICAGO 6, ILLINOIS

BALL BUSHING

The BALL BEARING for your

LINEAR MOTIONS

Sliding linear motions are nearly always troublesome. Thousands of progressive engineers have solved this problem by application of the Precision *Series A* or Low-Cost *Series B* BALL BUSHINGS.

Alert designers can now make tremendous improvements in their products by using BALL BUSHINGS on *guide rods, reciprocating shafts, push-pull actions,* or for *support of any mechanism that is moved or shifted in a straight line.*

Improve your product. Up-date your design and performance with BALL BUSHINGS!

Now manufactured for ¼", ½", ¾", 1", 1½" and 2½" shaft diameters.

LOW FRICTION • LOW MAINTENANCE
ELIMINATES BINDING AND CHATTER
SOLVES SLIDING LUBRICATION PROBLEMS
LONG LIFE • LASTING ALIGNMENT

Write for descriptive literature and the name of our representative in your city.

Progressive Manufacturers Use Ball Bushings
—A Major Improvement at a Minor Cost

THOMSON INDUSTRIES, INC.

Dept. C MANHASSET, N.Y.

Also manufacturers of NYLINED Bearings — DuPont NYLON within a metal sleeve—for rotation and reciprocation.

Keep Informed

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Petro-Chem Moves To Larger Offices

In order to accommodate all expanding departments in one location, Petro-Chem Development Co., Inc., engineers and designers of processing furnaces for the petroleum, chemical, and allied industries announce their move to new headquarters in the Chanin Building at 122 E 42nd St., New York, N. Y.

Koppers To Confine Piston Ring Production To Industrial, Aircraft

Koppers Co., Inc., announced that, effective April 1, it will confine its piston ring manufacturing operations to the company's expanding production of aircraft and industrial rings.

Announcing this change in operations at the Koppers piston ring plant which heretofore has also produced automotive rings, Walter F. Perkins, Vice President and General Manager of Koppers Metal Products Division, said:

By focusing all attention on these specialized fields the company will be able to provide even better products and services to the aircraft, industrial, marine, commercial engine, railroad and oil field applications. In these fields both original equipment and replacements are provided.

Under the changed plan of operations, advantages are three-fold: The services of a larger number of engineers will be available to work on industrial and aviation rings; more floor space will be devoted to production; and complete facilities of the fine metallurgical laboratories at the piston ring plant will now be devoted to work in the specialized fields.

In addition to providing facilities for the expanding industrial ring production, the change in manufacturing operations also will release space needed to expand operations of Koppers near-by Bartlett Hayward plant, which has accepted additional defense orders.

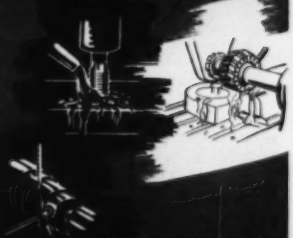
Koppers also has a number of new products under development and is negotiating for rights on others which may be produced.

Latest Catalogs

Small Tools

The New Brown & Sharpe No. 35 catalog recently has been announced to the trade. Issued in the large "standard" catalog size it contains 224 pages and presents the complete Brown & Sharpe line of Small Tools: Machinists' Tools, Electronic Measuring Equipment, Gages, Johansson Gage Blocks, Milling Cutters, Hobs, Arbors, Adapters and Collets, Screw Machine Tools, Pumps, and other widely used shop items, including Ground Flat Stock, Vises, and Permanent Magnet Chucks. Included with the catalog is a copy of the new price list containing the new ordering system which establishes product identification of every item in the catalog, regardless of type, size, style, or variation. It reduces ordering to the minimum and expedites handling of orders. Available from Brown & Sharpe Mfg. Co., Providence 1, R. I.

DIFFERENT



SUITED

THERE is no one cutting fluid that best meets the requirements of every job. Therefore, Stuart offers you a *complete* line of cutting fluids. Often two or three Stuart cutting fluids, or varying dilutions of one or two, will answer all the needs of a shop. But, what a whale of a difference it makes when the cutting fluid that is used is the right one for the job!

GEAR SHAVING TOOL LIFE INCREASED 80%, FINISH IMPROVED WITH STUART'S THREDKUT

In a Chicago plant, two gear shavers were run side by side on the same job, one with the old cutting oil, one with Stuart's THREDKUT. Tool life with "x" oil—6000 gears; with THREDKUT —*9000 gears!* Finish with the other oil—satisfactory until 2500 to 3000 gears had been produced, then deteriorating until tools were replaced; with THREDKUT —completely satisfactory at all times.

It pays to put the *right* cutting fluid on the job. Ask to have a Stuart sales-engineer call.

Send for NEW BOOKLET entitled "MORE THAN A COOLANT IS NEEDED"

D.A. Stuart Oil co.
EST 1865 LIMITED

2741 S. Troy St., Chicago 23, Ill.

Hydraulic Power Unit

Rivett Lathe & Grinder, Inc., Brighton 35, Boston, Mass., has published a new catalog, No. 400, describing its line of hydraulic power units in single pump, double pump, and combination pump types. The catalog lists all information necessary for efficient pump performance. Besides showing working drawings and specifications for the various sizes of pumps, the catalog contains maximum pressures at a given hp and hp requirements at given pressures.

Analog Transducers

The long-established need for an easy-to-use reference of transducers for use with cathode-ray oscillographs is now filled by a compilation made by the Instrument Div. of Allen B. Du Mont Laboratories, Inc., 1500 Main Ave., Clifton, N.J. The new compilation contains over 500 different types of analog transducers arranged alphabetically according to their functions. For each transducer, the following pertinent information is given as available from the manufacturer: Function; Principle of Operation; Accessories Required; Transfer Characteristics; Power Required; Amplitude Range; Sensitivity; Output Characteristics; Bandwidth; Resonant Frequency; Resolution or Precision; Linearity; Weight; Range; Sturdiness; Temperature Limitations; Mounting; Size; Remarks; and Model Designation. For radiation studies, a special section tabulating Geiger-Mueller Tubes is included. A transducer accessory listing has also been included, giving characteristics, remarks, uses, and manufacturer. Another section contains pertinent reference material quoting author and date of publication.

The complete compilation is available from the Instrument Div. of Du Mont for 50 cents a copy.

Explosionproof Motors

Construction details of Allis-Chalmers explosionproof, fan-cooled, and nonventilated motors are described in a new bulletin. These fan-cooled Type APZZ motors are available in ratings of 3 to 100 hp and the nonventilated Type APKK in ratings from $\frac{1}{2}$ to 2 hp. They meet all requirements of, and are approved by, Underwriters' Laboratories, Inc., for use in Class I, Group D, and Class II, Groups F and G atmospheres. Copies of the bulletin, "Allis-Chalmers Explosion-Proof Motors," 51B7286A, are available upon request from Allis-Chalmers Mfg. Co., 949 S. 70th St., Milwaukee, Wis.

...MEN AT WORK!

Beneath the surface of this undisturbed street in Washington, D. C. men are at work . . . reconditioning water pipelines with the Centriline process. Above ground, traffic flows smoothly . . . unobstructed by the usual men, machinery and excavations.

Because the Centriline process centrifugally applies cement-mortar lining to pipes in place, excavation time, overall costs and interruption to street traffic are kept at an absolute minimum. Couple these advantages with the fact that Centrilining permanently prevents corrosion and tuberculation, increases carrying capacity, reduces pumping costs, gives new pipe service at a fraction of the cost of new pipes, and you have the reason why more and more city engineers and officials are specifying Centriline for their pipeline projects.

CEMENT-MORTAR LININGS FOR PIPES IN POSITION

2,298,688 FEET OF EXPERIENCE

CENTRILINE CORPORATION

A subsidiary of Raymond Concrete Pile Company

140 CEDAR STREET, NEW YORK 6, N. Y.

Branch Offices in Principal Cities of United States and Latin America

ON THE WEST COAST, WRITE PIPE LININGS, INC., P. O. BOX 3428, TERMINAL ANNEX, LOS ANGELES, CALIFORNIA

THE 50th ANNIVERSARY

OF THE

FOUNDER

OF THE

GRATING INDUSTRY

Irving Subway Grating Co.

ESTABLISHED 1902

TIME TESTED PRODUCTS and SERVICE

CLEAN•DRY•SAFE•DURABLE

OPEN GRID

GRATING • FLOORING

STAIR TREADS

FLOOR ARMOURING

BRIDGE DECKING

"A Fitting Grating for Every Purpose"

OFFICES AND PLANTS AT

50-10 27 ST., LONG ISLAND CITY, N. Y.

18-10 10 ST., OAKLAND, CAL.

AGENTS IN PRINCIPAL CITIES

CONSULT PHONE DIRECTORY

Metal-Enclosed Switchgear

A 30-page illustrated booklet, No. B-5282, describing "Unitized Low-Voltage Metal-Enclosed Switchgear" is available from the Westinghouse Electric Corp., Box 2099, Pittsburgh 30, Pa. The booklet opens with an explanation of just what "unitized," low-voltage, metal-enclosed switchgear is, and outlines the applications, both indoor and outdoor, for which it is best suited. Completely described in the booklet are the types DB and DA drawout De-Ion® air circuit breakers that are the heart of unitized switchgear. Current ratings, interrupting ratings, and inspection, disconnection, and replacement data are included.

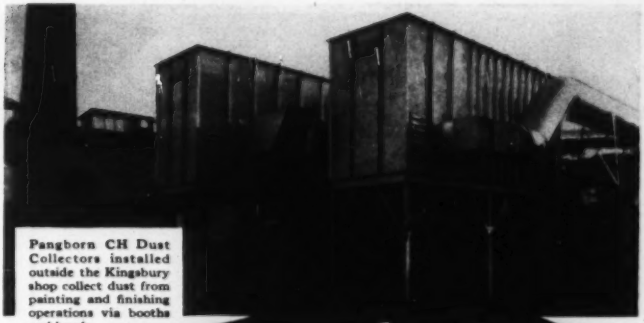
Standard switchgear assemblies, universal frames, and bus supports are described. Also covered are bushing-type current transformers, breaker attachments, and cascading and selective tripping. Information on how to order is supplied, and typical specifications are listed.

Industrial Springs

Engineers, designers, and manufacturers of products using flat springs as a power source will be interested in the information included in the multicolored 20-page brochure, "Sandsteel Springs for Dual Power," prepared by the Sandsteel Spring Div. of Sandvik Steel, Inc., 145 Hudson St., New York, N.Y. Charts point up the difference in performance of the various "qualities" of springs. The number of turns back from solid of a crosscurved spring is compared with the number required with a spiral quality spring, and it is indicated how a longer, thinner spring can be used when the crosscurved quality is employed—with resultant gain in spring performance. The increased number of turns and the drop in torque at full wind of the crosscurved spring, as compared with an ordinary quality spring, is charted in another illustration. A section is devoted to manufacture of the special steel necessary for springs.

Packaged Steam Generators

Publication of the first complete architects, and engineers' manual on packaged steam generators has been completed by the Industrial Div. of York-Shipley, Inc., York 4, Pa. This 208-page Steam-Pak architects' manual contains all the data required by an architect or engineer for laying out and writing specifications for boiler installations for applications requiring high-pressure steam, low-pressure steam, or hot water. Included in the manual are many color drawings showing application of and hook-ups for Steam-Pak generators for various types of process steam and heating applications. Alongside these drawings appear the complete specifications required for making the installation. The manual, contains complete specifications of the Steam-Pak line ranging in size from 15 to 250 hp. Each size of generator is built in three styles—high or low-pressure steam or hot water. Each Steam-Pak model can be fired with light oil, heavy fuel oil, gas, or a combination of gas and oil. Data given includes a complete description of each boiler and its firing equipment. Diagrams are also given of the piping requirements and connection sizes of each capacity steam generator. Another feature of this complete manual are electrical wiring diagrams and Steam-Pak output charts.



Pangborn CH Dust Collectors installed outside the Kingsbury shop collect dust from painting and finishing operations via booths and hoods.

One Pangborn Installation Solves 6 Dust Control Problems!*

Hoods exhaust dust from hand polishing and grinding booths to outside Collectors

FINISHING operations at Kingsbury Machine Tool Corporation presented a 6-fold dust control problem to Pangborn engineers. Several priming, lacquering and spray painting operations had to be protected from dust created in other finishing jobs such as snagging, grinding and smoothing.

To control these dusts efficiently, Pangborn recommended booths, tables and exhaust hoods. Four main booths, four snagging tables, one snagging bench and a bench grinder hood control the dust at the source. All these are exhausted to two CH Collectors located out-of-doors.

Kingsbury reports the complete system "highly satisfactory"—with these added benefits: Heating costs have been lowered substantially through recirculation of the cleaned air. Costly dust damage to adjacent machinery and products has been prevented. And workers' efficiency has increased due to cleaner working conditions.

What are your Dust Problems? Find out what Pangborn can do to solve them. Write today for Bulletin 909A. Address: PANGBORN CORPORATION, 2200 Pangborn Blvd., Hagerstown, Md.

Look to Pangborn for the latest developments in Dust Control and Blast Cleaning equipment

Pangborn DUST CONTROL

STOPS THE DUST HOG from stealing profits

Air Conditioning

A new book "How to Have a Carrier Weathermaker Home" describing dramatic and economical new home layout ideas now made possible by positive residential comfort control has just been released by Carrier Corp., 300 South Geddes St., Syracuse, N.Y. Pointing out how home design has lagged behind other changes in American life, the book outlines a new way of planning a home from the inside out, with complete freedom from many old technological restrictions.

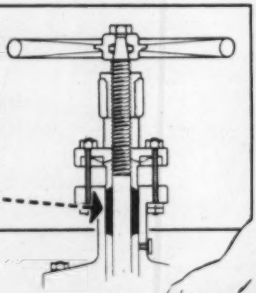
Steel Equipment and Production

"Allegheny Ludlum Serves the West," is a new bulletin which illustrates and describes the expanded facilities of the Allegheny Ludlum Steel Corp. on the Pacific Coast. Data on equipment and production (types, sizes, materials, etc.) of the company's Los Angeles Forge Plant; range of stock in its Tool Steel Warehouses at Los Angeles and San Francisco; sales and engineering representation in both of these cities and Seattle, in expanded modern quarters, is included.

Continuous Sampling Monitor

A new four-page, two-color bulletin on the continuous sampling monitor—a device to simplify quality control—is available from the General Electric Co., Schenectady 5, N.Y. The booklet, GEA-5738, contains photographs and diagrams of the equipment and explains the continuous sampling monitor's operation, construction, and range. It is designed to complement the company's bulletin GEA-5627 on quality control instrumentation.

"John Crane" Engineers Solve Difficult VALVE STEM PITTING PROBLEM with this new packing----------



Put "JOHN CRANE's" talents to work for you!

One of the nation's leading valve manufacturers* was confronted with the problem of 410 and 416 chrome-steel valve stem pitting during storage. "John Crane" Engineers were asked to solve the riddle which had proved very costly. This resulted in the development of a new packing (Style 187) which contains a special sacrificial metal used to short-circuit the electrolytic action that causes pitting. This company has used the new packing over a year and is thoroughly satisfied not only with its corrosion inhibiting qualities but also its operating performance on steam to 850° F.—1500 psi.

This is a typical example of the thousands of packing problems "John Crane" has solved throughout industry. Why not give us the opportunity of working with you to find the most practical and economical solution to your particular problems?

*Name sent on request.

Write today for complete details

CRANE PACKING COMPANY
1814 CUYLER AVENUE • DEPT. ME4 • CHICAGO 13, ILLINOIS

Alkalinity-Reducing Ion Exchanger

Announcement of its alkalinity-reducing ion exchanger for use in boiler plants where raw water alkalinities are high and chlorides and sulphates are in a moderate range is made in a new leaflet, No. 28 × 7808, released by Allis-Chalmers Mfg. Co., 949 S. 70th St., Milwaukee, Wis. The leaflet includes a graphic illustration of the simplicity of equipment of the new exchanger and its effectiveness in controlling hardness, total alkalinity, and CO_2 in the steam in contrast to other methods which have been used for this purpose. This salt-splitter system is particularly suitable for treating make-up for boilers where the steam is used primarily for heating and a large percentage of condensate is returned. It removes alkalinity and hardness by means of two resin beds in one tank and requires only salt, no acid, for regeneration.

Metric Equivalents Chart

As a special service to the engineering trade The Frederick Post Co. has compiled a combination conversion and decimal equivalent chart which converts inches to feet and metric equivalents on one side. On the other side of this chart are the standard decimal equivalents. Its size 17 × 22 in., protected with tin at both top and bottom, ready for hanging. These charts are from The Frederick Post Co., 3650 N. Avondale Ave., Chicago 18, Ill. Ask for Chart C.

Metal Working Shaper Operation

Another new How-to book has just been published by the South Bend Lathe Works. Titled "How to Run a Metal Working Shaper," the handy volume is designed to be a manual for the South Bend 7 in Shaper.

Thoroughly covering the set-up and operation of the metal working bench shaper, this 32-page handbook will aid the experienced machinist as well as the apprentice and student. Over 65 photos, diagrams and exploded views clearly show the internal parts of a shaper, how to grind differently formed tool bits for shaper cuts and how to handle the many job set-ups used in shaper work.

Shop men especially will appreciate the simple, easy to follow steps and pictures outlined in the manual. Written so that the fine points of shaper operation will not go over the beginner's head, yet the experienced operator will find many tricks of the trade and machining short cuts which will prove helpful in his work.

Selling for 25¢ each, copies of "How to Run a Metal Working Shaper" may be obtained from any South Bend distributor or by writing directly to the South Bend Lathe Works, South Bend 22, Ind., U. S. A.

Keep Informed

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Drafting Machine Scales

Universal Drafting Machine Corp., 7960 Lorain Ave., Cleveland, Ohio, is introducing a line of standard improved metal drafting machine scales marketed under the trade name "Duraline." The line consists of 12 standard types of graduations most used by civil, mechanical, and electrical engineers, draftsmen and architects. Each style is available in 6, 12, 18, and 24-in. lengths. A descriptive bulletin showing all 12 standard scales in three-quarter size, is available.

Electric Power

An 8-page case history describing the operation of the largest independent producer of electric power for manufacturing in Connecticut, Scovill Manufacturing, is now available. The equipment and operating philosophy which enabled this plant to achieve an evaporation rate of 12.8 and a cost per thousand pounds of steam of $.706 is fully covered. Use of steam, fuel, and ash handling, and plant steam demand are discussed and illustrated. A large schematic drawing reveals the operation of the combustion-control system; in addition, a drawing of the instrument panel is tied into actual photographs of functions performed by particular controllers. Write for bulletin R-8 from The Hays Corp., Michigan City, Ind.

Flowmeters

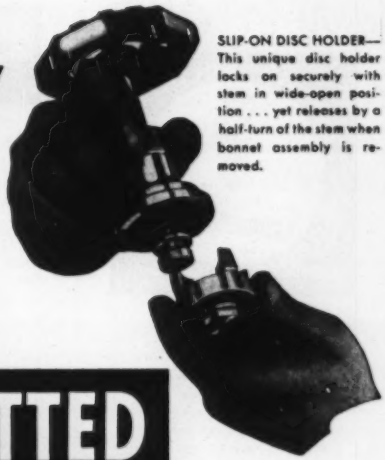
A new 40-page bulletin describing the company's "Series 500" line of flowmeters has been published by The Bristol Co., Waterbury 20, Conn. The bulletin, No. F1605, describes instruments for recording, integrating, indicating, automatic controlling, and telemetering the flow of steam, water, air, gas, oil, solutions, and other fluids. Both mechanical and electric-type flowmeters are described in a full range of models suitable for a wide variety of uses in industrial plants, utility companies, and process control work. Complete information is given on the various types of meter bodies, operating principles, primary devices for flow measurement, recording charts, and accessories. In addition to numerous photographs, the bulletin is liberally illustrated with reproductions of actual recording charts, and sketches of typical methods of applying the instruments.

Condensifilter

The Hankison Model B-30 Condensifilter, a device which dehydrates and cleans compressed air used for operating instruments, is detailed in a new 2-page bulletin. Measuring only 15 in. high × 9 in. in diam., the Condensifilter combines in a single compact unit—a mechanical filter, a dehydrator, and an automatic trap. When connected to a compressed air line, it removes entrained and vaporized water and oil, oil sludge, scale, and other foreign materials from the air. Rated capacity is 30 cfm at 100 psi; but when greater capacity or uninterrupted service is required, several units can be installed in parallel. Copies of bulletin B-30 may be obtained from Hankison Corp., 309 Renton Building, 1501 Beaver Ave., Pittsburgh 33, Pa.

KENNEDY

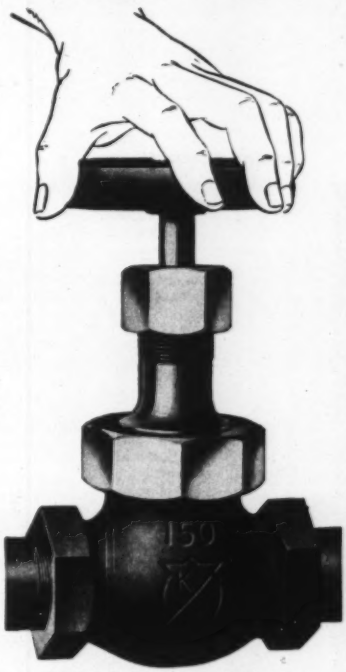
bronze globe valves...



SLIP-ON DISC HOLDER—This unique disc holder locks on securely with stem in wide-open position . . . yet releases by a half-turn of the stem when bonnet assembly is removed.

JOB-FITTED

for longer service, easier maintenance



KENNEDY Fig. 89, Bronze Globe Valve 150 lbs. steam, 300 lbs. WOG, non-shock

YOU KEEP MAINTENANCE COSTS DOWN with KENNEDY Bronze Valves because they are *job-fitted*—every valve specially designed and engineered for the job it has to do.

THE KENNEDY FIG. 89, for example, is designed for services where frequent inspection, cleaning of internal parts and quick renewal of the composition disc are required.

HEAVY UNION BONNET RING permits easy dismantling and reassembly of the valve without risk of damage to body-bonnet bearing surfaces.

RENEWABLE COMPOSITION DISCS are available in a variety of materials to meet a wide range of fluid, pressure and temperature requirements.

RUGGED BODY has an unusually high seat to prolong disc life by utilizing full thickness of disc before disc-holder strikes the base of the raised seat.

LONG-WEARING PACKING—molded rings of lubricated asbestos—maintains easy operation and tight seal to prevent leaks. Valve can be repacked under pressure.

FOR BEST RESULTS and real economy, standardize on KENNEDY Bronze Valves . . . and the complete line of KENNEDY Iron Valves, Malleable, Cast-Iron and Bronze Pipe Fittings.

Write for Circular 101—Buy from Your Local Distributor

Est. 1877

THE **KENNEDY**
VALVE MFG. CO. • ELMIRA, N.Y.

VALVES • PIPE FITTINGS • FIRE HYDRANTS

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FOR INDUSTRIAL APPLICATIONS REQUIRING POSITIVE CONTROL OF PRESSURE, TEMPERATURE, LIQUID LEVEL ETC.

They Have What Experienced Engineers Want—
POSITIVE SAFETY
EASE OF INSTALLATION
CONVENIENT ADJUSTMENTS
YEARS OF DEPENDABLE PERFORMANCE

CONTROLS PERFORM IMPORTANT RESPONSIBILITIES, AND SHOULD BE SELECTED WITH DISCRIMINATION

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- Tandem Block Combustion Units
- Fuel Oil Pump Sets
- Refractory Burner and Muffle Blocks
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NATIONAL AIROIL BURNER COMPANY, INC.

239 E. Sedgley Ave., Philadelphia 34, Pa.
Southwestern Division: 2512 So. Blvd., Houston 6, Tex.

Keep Informed — New Equipment — Business Notes — Latest Catalogs

Stroboscopes

The complete line of General Radio stroboscopes are described in a new bulletin. An explanation of how the stroboscope works is given, together with specific applications of the different instruments. Detailed specifications and prices are included. Available from General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.

Pipe Lines

A new engineering bulletin, "Bouncing Pipes," has been published by Burgess-Manning Co., 1203 Dragon St., Dallas, Texas. This bulletin discusses the fundamental concepts of the oscillating flow of gas in pipe lines in a language that the layman can understand. It is liberally sprinkled throughout with interesting sketches.

Metal-Working Presses

American Steel Foundries, Elmes Engineering Div., Cincinnati 29, Ohio, announces availability of a 12-page bulletin, No. 1010-B, which illustrates and describes Elmes hydraulic metal-working presses. Electric control provides semiautomatic operation, automatic operation, and inching, with speed change and reversal of slide governed either by ram travel or pressure, whichever is preferable.

Reprints Available

Two articles authored by Allis-Chalmers engineers and published in the third quarter, 1951, Allis-Chalmers *Electrical Review*, are now available from Allis-Chalmers Mfg. Co., 949 S. 70th St., Milwaukee, Wisconsin.

The one, No. 05R7773, entitled "Supercharged Cooling of Generators," is by Sterling Beckwith, engineer-in-charge of a-c design, in the company's motor-generator section. It describes some of the most important steps that have been taken in the design of the first supercharged hydrogen-cooled generator. The second, No. 05R7776, "Five States to Stability," is by H. D. Timm, engineer, and T. B. Montgomery, engineer-in-charge, control section. It describes how discrepancies in generator output voltage are corrected by a series of amplifying stages in "Regulex" regulators.

Rotary Pumps

A new bulletin describes the De Laval A313B IMO rotary pump. The De Laval A313B IMO pump is a general-service screw-type rotary pump designed for handling petroleum products, and other light viscous fluids as required for hydraulic systems, rotary and steam-atomizing oil burners, lubrication, governing systems, and similar services. Capacities to 80 gpm, pressures to 275 psi (continuous) and to 325 psi (intermittent). The bulletin contains a cutaway section of the pump, complete description, viscosity tables, and dimensions for various frame sizes. The main features of the pump include: pulsation free flow, mechanical shaft seals, prelubricated bearings, and optional types of mountings. It can be mounted in any position and be driven by direct-connected shaft, V-belts, or chains. Available from De Laval Steam Turbine Co., Trenton 2, N.J.

Nylon-Lined Bearings

The operating principles, design, advantages, and application of Nylined bearings for rotation and reciprocation are set forth in a 4-page bulletin issued by Thomson Industries, Inc., Manhasset, N. Y.

Soot Blowers

Diamond Catalog No. 1014 describes the complete line of Diamond Soot Blowers for both air and steam cleaning and having manual, air, or electric operation. Completely automatic sequential systems are described and their advantages discussed. This catalog also contains some interesting background material indicating that soot is a better insulator than asbestos. Write to Diamond Power Specialty Co., P. O. Box 415, Lancaster, Ohio.

Universal Testing Machines

A new 32-page catalog on hydraulic universal testing machines contains illustrations, specifications, and operating details on machines with capacities up through 400,000 lb. Four different models of hydraulic universal testing machines are described, composed of various combinations of loading units and indicating units. There is also a section on accessories and instruments. Copies of the new catalog, No. RU-7-52, can be obtained from Riehle Testing Machines Div. of American Machine and Metals, Inc., East Moline, Ill.

Production-Tip Movies for Your Meetings!

without cost or obligation!

- Action-packed . . . production-boosting 16mm films for your next technical meeting, training school program or production clinic.
- "MULTIPRESS — and how YOU can use it" . . . Multipress at work on a wide range of actual, unstaged operations such as broaching, trimming, forming, marking, crimping, assembling, staking and testing. (30 minutes long.)
- "INDEX TO PROFITS" . . . Follow the assembly of an intricate 34-piece automobile door latch through a highly compact, production line that saves space and cuts lost motion to the minimum. (20 minutes running time.)
- WRITE DENISON or contact the Denison representative in your area giving your film choice and showing date.

The Denison Engineering Company
1189-A Dublin Road Columbus 16, Ohio

DENISON Hydraulics

Combustion Control

A detailed account of tried and proved automatic combustion-control techniques for oil and gas-fired boilers is now available in a 24-page, tri-colored bulletin, No. 1023. Comprehensive illustrations and descriptions include lucid diagrammatics showing nine typical firing methods and 16 major control equipment components. There are also individual facts and figures on 300 installations throughout the U.S.A., ranging from 6000 to 1 million lb per hr capacity. Available from Bailey Meter Co., 1026 Ivanhoe Rd., Cleveland 10, Ohio.

Power Plant Operation

A unique composite flow diagram of a typical steam electric-generating station operating at pressure between 250 and 2500 psi, prepared by the engineering staff of Edward Valves, Inc., 1200 W. 145 St., East Chicago, Ind., is now available upon request. Printed in four colors, the Edward 11 × 20 in. Flow Diagram illustrates with unusual clarity the functional lines of a modern power plant, the principal equipment, and a large number of valves required for controlling flow in the various piping systems. Different valve types are represented by symbols and abbreviations. All important lines carry designations, with sizes indicated in proper relationship to an 8-in. main steam line.

Life-Line Motors

Design and application features of Life-Line motors (now made in ratings up to 700 hp) are described in a new 20-page booklet, No. B-4731, available from Westinghouse Electric Corp., Box 2099, Pittsburgh 30, Pa. Life-Line motor applications in the paper, chemical, central-station, mining, lumber, and metal-working industries are illustrated and separate sections describe the special construction of motor frames, end brackets, stators, rotors, and bearings. Standard and special mountings and enclosures also are described.

Measuring Magnetic Properties

A new bulletin No. GEC-777, describing the application and operation of equipment used for measuring magnetic properties is available from the General Electric Company's Meter and Instrument Department, Schenectady 5, N.Y. The publication describes the G-E gauss meter, indicating fluxmeter, recording fluxmeter, and fluxmeter calibrating unit. These instruments provide proper measurements of magnetic properties such as flux density, flux direction, and total flux, all of which are essential to the continued industrial progress made possible by research.

Tube-Supported Walls

A new 12-page 2-color catalog on tube-supported walls for industrial boilers is available from Bigelow-Liptak Corp., 2842 W. Grand Boulevard, Detroit 2, Mich. The catalog describes in detail how Bigelow-Liptak walls may be suspended directly from boiler tubes with resulting savings in steel and erection time. Engineering drawings show typical jobs and describe how the enclosure is fastened to the boiler tubes. Of particular interest is the inside spread which shows a series of photos of a job being erected.

Oil Burners

An 8-page, 2-color catalog describing its complete line of Hev-E-Oil Burners has been published by the Cleaver-Brooks Co., 326 East Keefe Ave., Milwaukee, Wis., manufacturer of equipment for the generation and utilization of heat. The catalog contains illustrations of the various sizes and capacities of the burners—including burners with maximum capacities of 5 to 60 gal. Featured in the catalog is the fact that the Hev-E-Oil Burner is designed to utilize heavier grades of fuel oil, up to free-flowing, low-cost, No. 5, as well as present-day light oils, with the result that the line has been accepted as an efficient burner in both commercial and industrial applications.

BLAW-KNOX GRATING

Electroforged into rigid, one-piece panels. Twisted cross bar prevents slipping.

...GIVES BETTER SERVICE ON 5 COUNTS

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2 GREATER STRENGTH
3 LONGER LIFE
4 LOWER MAINTENANCE
5 MORE OPEN SPACE

Bring your open steel flooring problems to Blaw-Knox for expert help. Bulletin 2365 sent on request.

BLAW-KNOX DIVISION of Blaw-Knox Company
2105 Farmers Bank Bldg., Pittsburgh 22, Pa.

BLAW-KNOX Electroforged STEEL GRATING

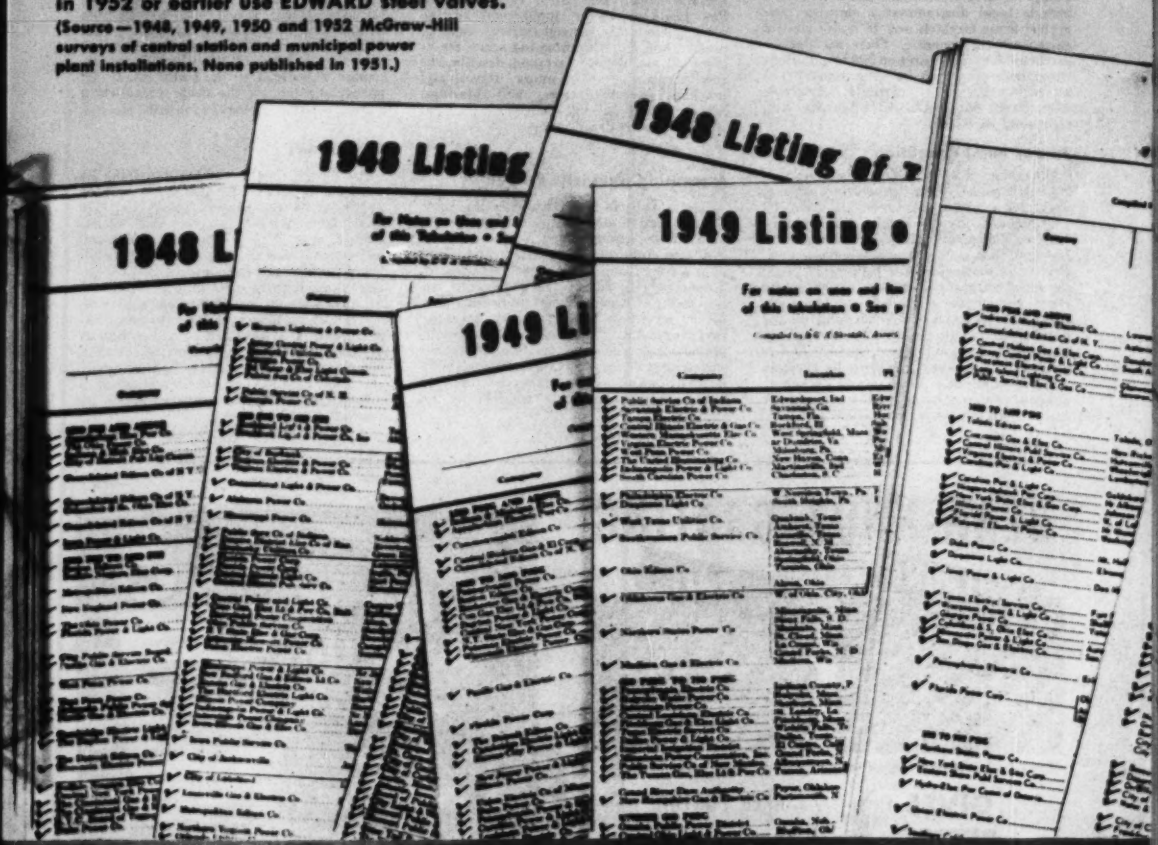
• It describes and illustrates all models Bin-Dicator bin level indicators for thin or thick walled bins, inside or outside location and suspended interior installation in tanks, silos, hoppers and bins. Also describes Bin-Flo Aerator for keeping pulverized materials moving. Many wiring diagrams. Write for this helpful new catalog.

THE BIN-DICATOR CO.
13946-W Kercheval • Detroit 15, Mich.

Again it's Edward Valves in over

THE EVIDENCE: **456 out of 476 (95.8%) of new central station and municipal power plant projects scheduled to start operation in 1952 or earlier use EDWARD steel valves.**

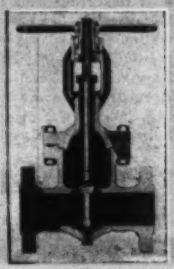
(Source—1948, 1949, 1950 and 1952 McGraw-Hill surveys of central station and municipal power plant installations. None published in 1951.)



TYPICAL EDWARD DESIGNS GOING INTO NEW STATIONS

Cast Steel Non-Return

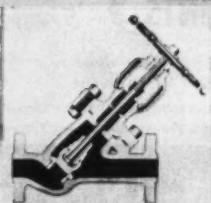
Cast Steel Stop


Cast Steel Gate

Cast Steel Check

Forged Gage

Forged Stop

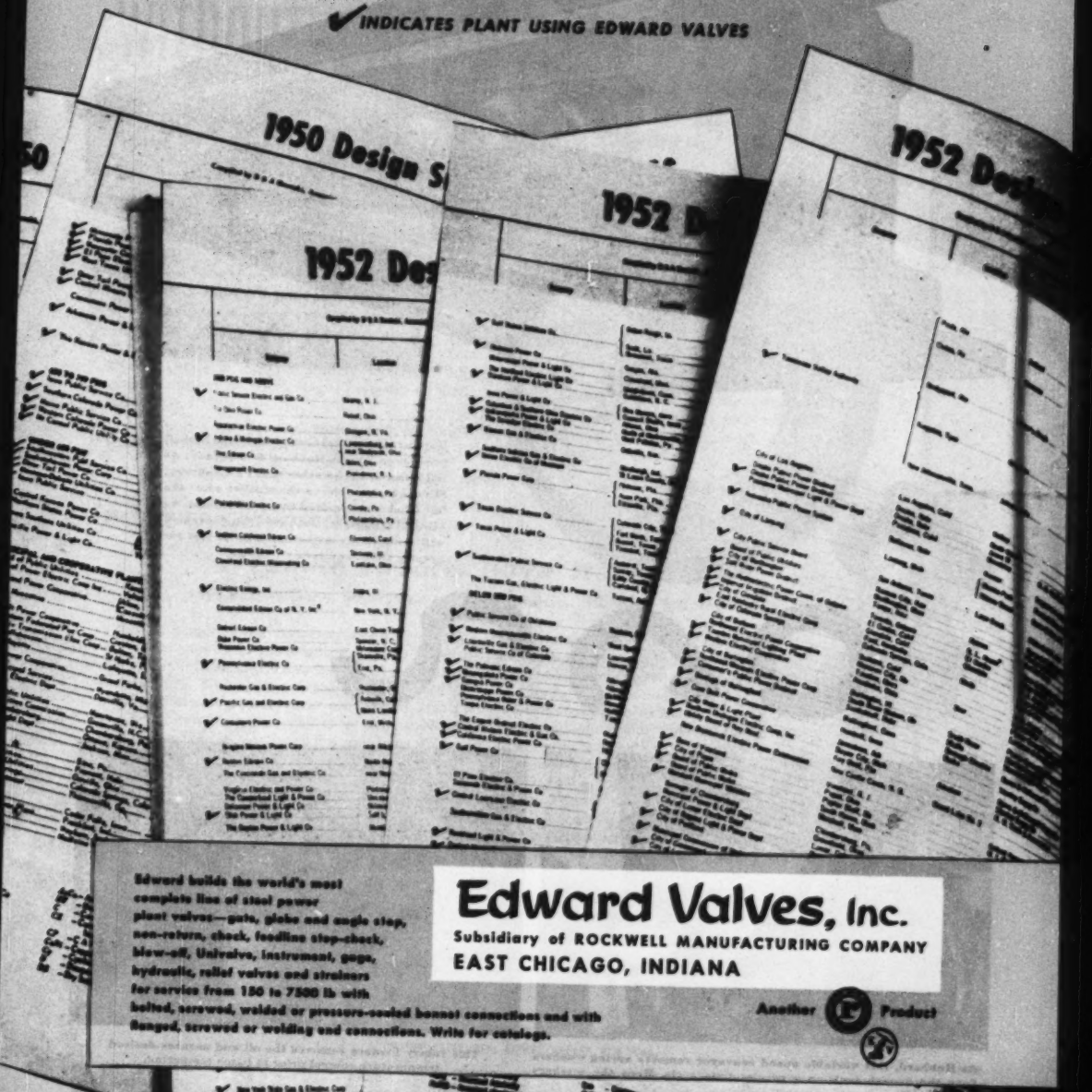

Blow-off

Forged Instrument

Forged Univalves

95% of new power plant projects

✔ INDICATES PLANT USING EDWARD VALVES



Edward builds the world's most complete line of steel power plant valves—gate, globe and angle stop, non-return, check, feedline stop-check, blow-off, Univalve, instrument, gage, hydraulic, relief valves and strainers for service from 150 to 7500 lb with bolted, screwed, welded or pressure-sealed bonnet connections and with flanged, screwed or welding end connections. Write for catalogs.

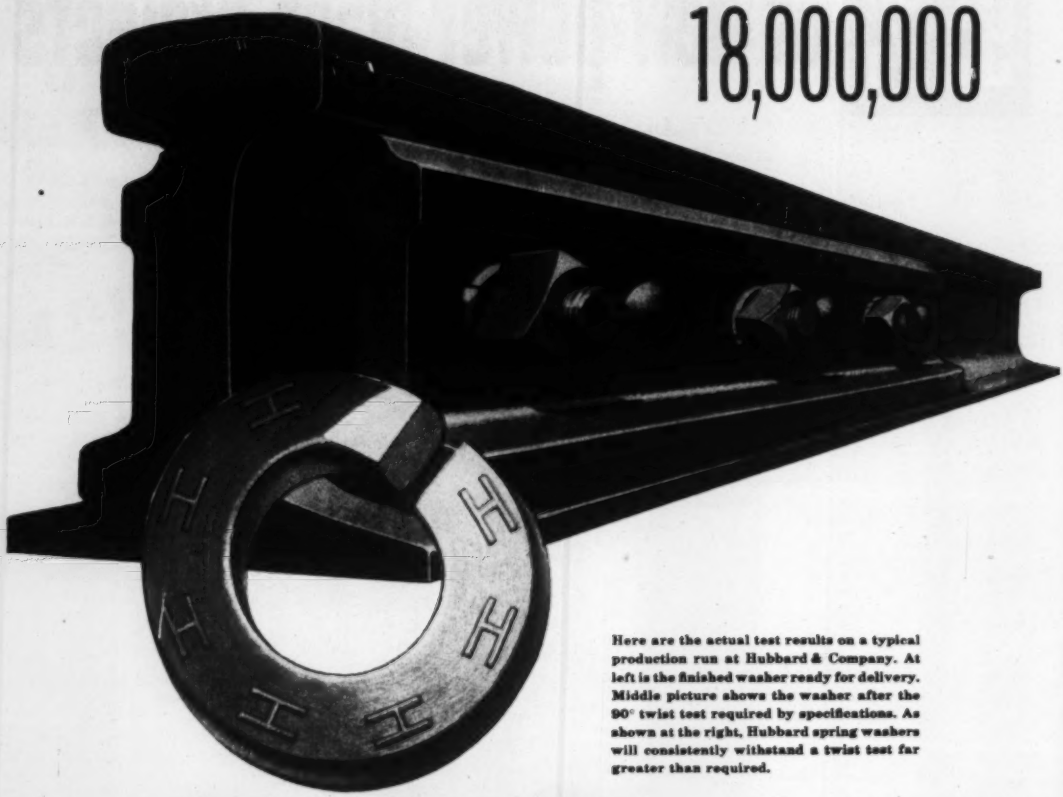
Edward Valves, Inc.

Subsidiary of ROCKWELL MANUFACTURING COMPANY

EAST CHICAGO, INDIANA

Another Product

HOW TO GET THE MOST OUT OF THE 18,000,000



Here are the actual test results on a typical production run at Hubbard & Company. At left is the finished washer ready for delivery. Middle picture shows the washer after the 90° twist test required by specifications. As shown at the right, Hubbard spring washers will consistently withstand a twist test far greater than required.

At Hubbard, this variable speed conveyor removes spring washers from the quench tank on a precise time cycle. Here, the washers enter a low temperature rotary furnace.

This rotary furnace removes the oil and assures desired temperature control prior to batch tempering.

LEAN ALLOY STEEL YOU'RE GETTING

Carilloy spring washers used without one reported failure!

thanks to U·S·S metallurgical assistance

HUBBARD & COMPANY, Tool Division, Pittsburgh, Pa., is a major producer of rail joint spring washers. These vital washers are used on the bolts of the joint bars that connect sections of railroad rails. They prevent the bars from "freezing" and interfering with expansion and contraction of the rails. Battering and wear at the rail ends is reduced due to the high bolt tension caused by the reactive pressure of these CARILLOY steel washers.

You could hardly find worse service conditions. Temperatures often vary 50, 60, even 70 degrees in a single day. And, because they are part of the rail joint, these washers must cushion the wheel load shock of trains that every day become longer, heavier and faster.

Some time ago, our metallurgists got together with Hubbard engineers and came up with a vastly improved method of heat treating these alloy steel washers. This heat treating system has achieved uniform heating, precisely timed quenching and fool proof tempering. Result: a higher quality product, more uniform than ever before.

HERE'S THE COMPLETE STORY:

"Failure reports have stopped"

says B. J. McTighe, Superintendent, Tool Division, Hubbard & Company

"Since installing our new heat treating system, we've sold about 18,000,000 spring washers without one reported failure. The improved heat treatment, suggested by United States Steel, has resulted in more uniform structure, better mechanical properties and a retention of spring properties under all conditions. We can meet specifications even if alloy steel restrictions become more rigid in the future.

"These spiral spring washers, made from CARILLOY 9260 steel, are hardened to an average of 49/52 Rockwell C. Despite this high hardness, the washers easily meet the specification requiring a 90° cold twist in the fully heat treated condition. Our own shop control limits are even more severe than this to make sure that we meet and exceed railroad standards.

"These washers have exceptionally high and uniform reaction values. After they are compressed, these washers return to their original contour while retaining their spring properties. We think the superior performance is due to our improved heat treating system."

If you're having trouble handling lean alloys, we may be able to suggest heat treatment methods that will give you more uniform hardness, less rejects and less retreatments. Simply call or write our nearest district sales office.

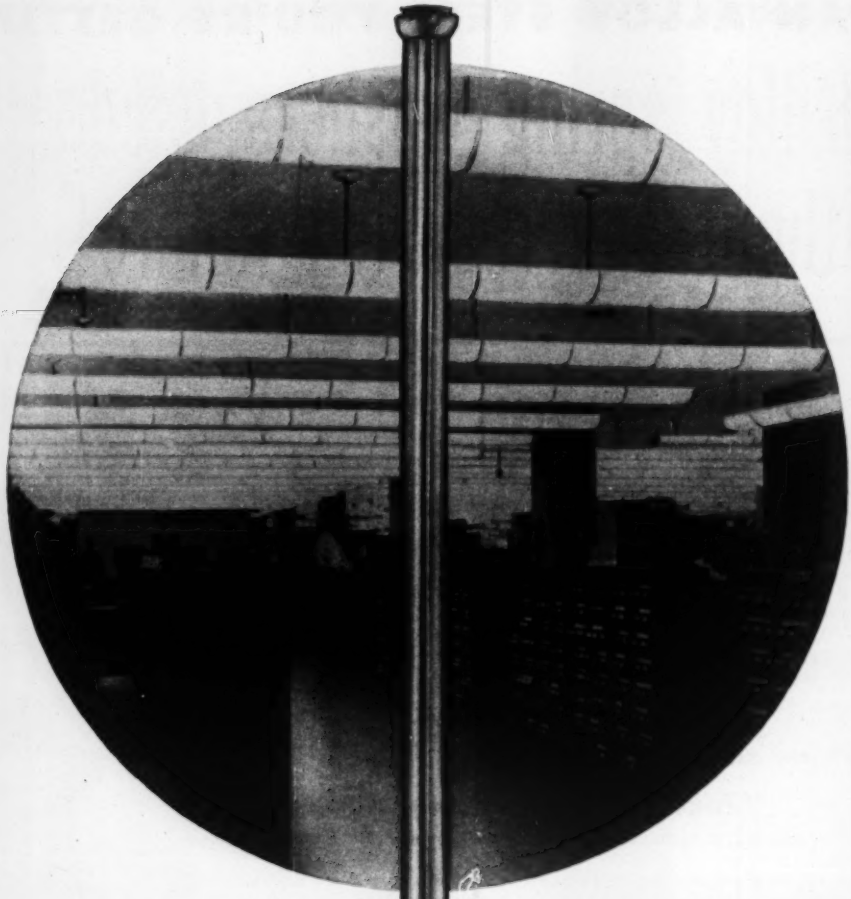
U·S·S Carilloy Steels

USS

UNITED STATES STEEL COMPANY, PITTSBURGH • COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO
TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA. • UNITED STATES STEEL SUPPLY DIVISION, WAREHOUSE DISTRIBUTORS, COAST-TO-COAST
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

2-350

UNITED STATES STEEL



REVERE BRASS TUBE HANGS UP 25 MILES OF LIGHT

In the General Accounting Office Building in Washington there are luminous indirect fluorescent lighting fixtures which if put end to end would reach across country for 25 miles. This is possibly the most spectacular fact about the installation. So many lighting units are needed in this seven-story structure because it occupies an entire city block and has no court to admit daylight to interior areas. There are 10,000 employees, and large numbers spend all their working hours under electric illumination. The reflectors are made of extruded Plexiglas acrylic plastic, and deliver 90% of the light to the ceiling, from which it is reflected downward, preventing glaring dazzle spots. There are nearly 33,000 lighting units in the building. A Revere man who visited the office reports that the lighting is perfect.

The units or luminaires were made by the F. W. Wakefield Brass Company, Vermilion, Ohio, using Revere Brass Tube for the hanger stems. At one end the tube had to be threaded for a length of two inches and flared at the other. The stem is then chrome-plated. Brass lends itself ideally to these operations. Revere will gladly collaborate with you on the specification and fabrication of Revere Brass.

REVERE

COPPER AND BRASS INCORPORATED

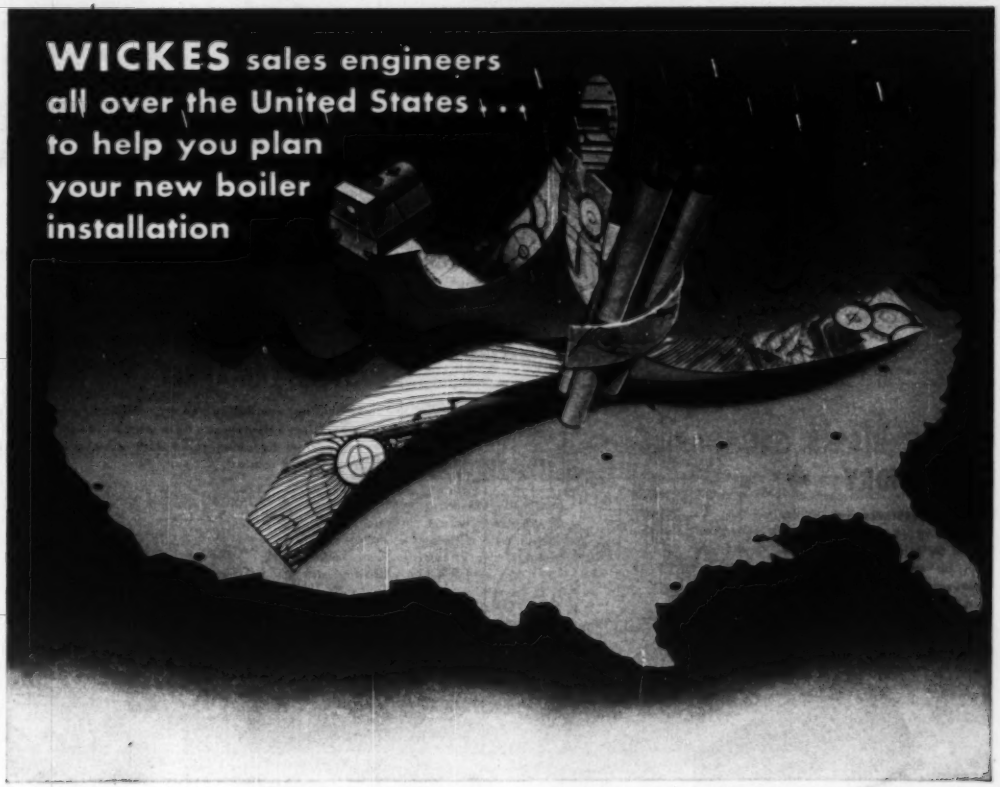
Founded by Paul Revere in 1801

230 Park Avenue, New York 17, N. Y.

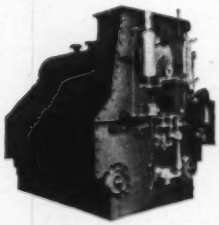
• • •

Mills: Baltimore, Md.; Chicago and Clinton, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Rome, N. Y.— Sales Offices in Principal Cities, Distributors Everywhere

SEE REVERE'S "MEET THE PRESS" ON NBC TELEVISION EVERY SUNDAY



In twenty-three principal cities in the U. S. and in several industrial centers outside the country there is a Wickes sales engineer—who really knows boilers—ready to help you. This widespread sales organization, alone, helps greatly to increase the service you get from Wickes, and once you place an order for a Wickes boiler, Wickes engineers and production men get into production without delay. Wickes knows that when you want steam generating equipment, you want it. A Wickes installation is a complete installation. One contract covers all controls, all accessories, all engineering, all work from original survey to final brick-work and installation ready-to-go. ✓ ✓ ✓ Throughout the world, industries and institutions that depend on steam have learned to depend on Wickes for efficient, low cost steam power. Wickes can fill your requirements for steam generating equipment up to 250,000 lbs. per hour and 1000 psi.—all types of multiple drum boilers adaptable to any standard method of firing. Write today for complete information or consult a Wickes sales engineer.



WICKES THE WICKES BOILER COMPANY

DIVISION OF THE WICKES CORPORATION, SAGINAW, MICHIGAN

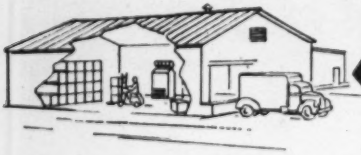
SALES OFFICES: Atlanta • Boston • Buffalo • Chicago • Cincinnati • Cleveland • Denver • Detroit • Greensboro, N.C. • Houston • Indianapolis • Los Angeles • Memphis • Milwaukee • New York City • Pittsburgh • Portland, Ore. • Saginaw • San Francisco • Springfield, Ill. • Tampa, Fla. • Tulsa • Washington, D.C.

141

RECOGNIZED QUALITY SINCE 1854

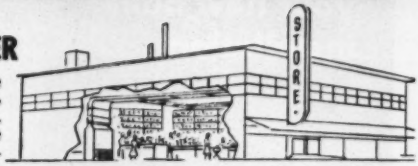
DRAVO *Counterflo*

A POSITIVE *SOLUTION* FOR



1. INDUSTRIAL CENTER

Where space is limited or roof heat losses are unusually high, Dravo Heaters require minimum space . . . no expensive boiler plant; roof heat losses low due to controlled recirculation of air; can be used with or without ducts.



3. SUPERMARKET

In heating, ventilating and air conditioning large areas, Dravo Heaters can tie in with air conditioning system by using same duct work, provide year-'round comfort.

2. FOUNDRY

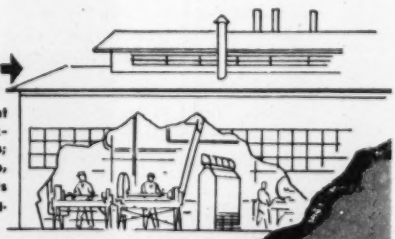
Negative pressures, caused by exhausting foul air, are balanced by tempering fresh outside air with Dravo Heaters. Atmosphere is kept healthy, constant temperatures are maintained, worker efficiency improves.

4. MEDIUM-TEMPERATURE CURING

In controlling temperatures and air moisture content in process manufacturing, Dravo Heaters have automatic controls, maintain constant temperature, can recirculate air to control curing process.

5. MACHINE SHOP

For comfort heating large plant areas, Dravo Heaters have maximum air throw in all directions; can be turned off during idle time, warm up quickly, keep fuel costs low, can heat 4,000 to 20,000 sq. ft. area, no duct work required.



Approved by American Gas Association

Listed by Underwriters' Laboratories, Inc.

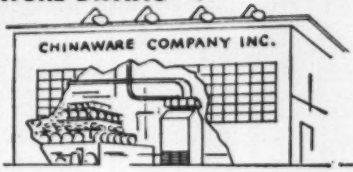
ACCEPTANCE BY FACTORY MUTUAL ENGINEERING DIVISION OF DRAVO STANDARDIZED SAFETY CONTROL CIRCUIT.

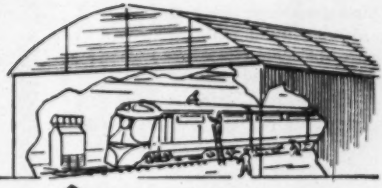
HEATERS.....

8 DIFFERENT HEATING PROBLEMS!

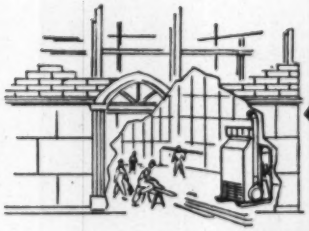
6. MEDIUM-TEMPERATURE DRYING

In removing moisture in drying operations, Dravo Heaters provide low-cost heat at even, predetermined temperatures; are automatic in operation, can use gas or oil, are readily converted.





7. TEMPORARY HEATING



For building construction projects where ground temperature must be kept above freezing, Dravo Heaters are quickly installed, easily moved to any location; can be later used as permanent heating plant for the new building.

8. RAILROAD REPAIR SHOP

In providing ample heat for repairmen in large buildings, Dravo Heaters keep heat where it's needed . . . at the working level; directional nozzles easily adjusted to suit conditions; heaters can be mounted on walls or hung from ceiling in any position.

DRAVO *Counterflo* HEATERS CAN SOLVE SIMILAR PROBLEMS IN THESE INSTALLATIONS, TOO

Comfort Heating and Ventilating in schools, churches, auditoriums, laundries, restaurants, garages, factories.

Process Drying of wood, rubber and paint; rug drying; auto laundry operations.

Process Curing of concrete pipe linings, farm crops, paper and fibres.

DRAVO HEATERS OFFER YOU . . .

- Low initial cost—users report 20% to 60% savings.
- Easy installation—electrical, fuel and exhaust connections are only requirements.
- Flexibility—where floor space is limited, can be wall-hung or suspended from trusses.
- Low fuel cost—direct-fired . . . burn gas or oil . . . units readily converted.
- Automatic operation—low-cost or modulating controls.
- Long service life—stainless steel combustion chamber eliminates refractory lining . . . low maintenance costs.

MAIL THIS COUPON FOR MORE INFORMATION . . .

DRAVO

CORPORATION

PITTSBURGH • ATLANTA • BOSTON • CHICAGO • CLEVELAND
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Sales Representatives in Principal Cities

Manufactured and sold in Canada by Marine Industries, Ltd., Sorel, Quebec. Export Associates: Lynch, White & Co., Washington 5, D.C.

Heating Department
Dravo Corporation
Dravo Building, Fifth and Liberty Avenues
Pittsburgh 22, Penna.

☐ Please send me Bulletin No. TU-523-13
☐ Please have a representative call.

Name_____

Title_____

Company_____

Address_____

City_____ Zone_____ State_____

A Lot of Dependability in a Small Package

Thousands of industrial firms recognize the Cuno AUTO-KLEAN disc-type strainer as an indication of *protection* on lube and hydraulic systems.

They know the machine builder has provided the best means of keeping fluids *clean* . . . when he has installed the AUTO-KLEAN as standard equipment.

They appreciate, too, the ease with which the AUTO-KLEAN works. A turn of a handle—periodically by hand or continuously by automatic means—is all that is necessary to keep the strainer *itself* clean. This is done without stopping flow. And there's nothing to replace or renew.

They also know that the AUTO-KLEAN is *guaranteed* to remove 100% of the solids larger than specified*. . . with minimum pressure drop.

The Favorite of Designers

The Cuno AUTO-KLEAN solves other problems *right on the board.*

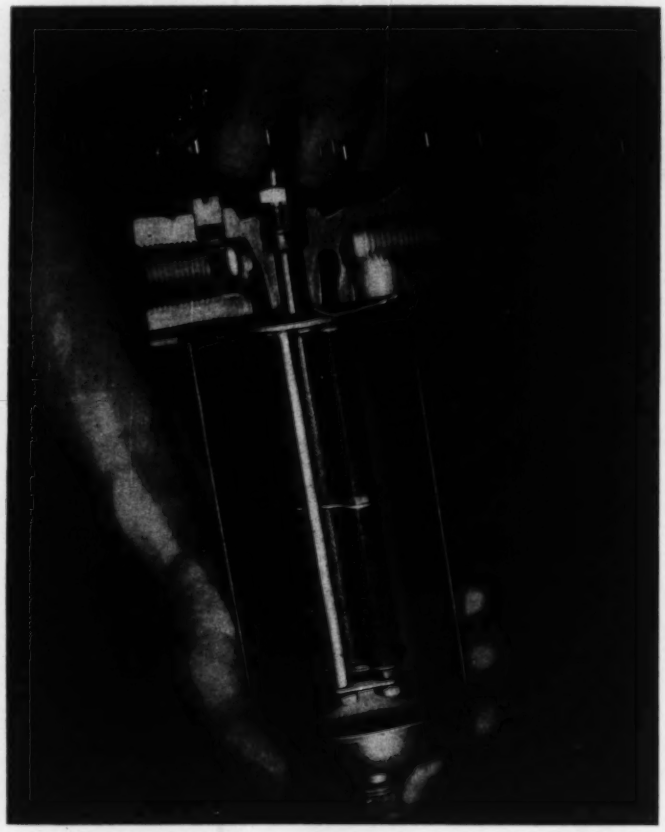
It's compact. A single unit handling full flow (from a few to more than 4000 gpm) occupies no more space than the usual partial-flow type.

You can build it in—or mount it externally. Inlet and outlet can be in any position. You can install it on low pressure or gravity feed or suction with no loss of efficiency.

And you can depend upon it lasting as long as the equipment on which it is installed because it is all-metal and non-collapsible and can be made of a wide range of materials for various fluids, viscosities, temperatures and solids to be handled.

*Available spacings from .0035 in. to .062 in.

Cuno Engineering Corporation
Dept. 651 A, South Vine St., Meriden, Conn.
Please send information on Cuno AUTO-KLEAN
for .....
Name .....
Company .....
Address .....
City ..... Zone .... State ....
Please attach to business letterhead



You Can Clean This Fluid Strainer Without Stopping the Flow

Cuno AUTO-KLEAN is the *only* fluid strainer with "comb-action cleaning" which permits it to work uninterruptedly. Dirt accumulations are dislodged *while* the straining goes on. This can be done automatically. *Guaranteed* to remove 100% of all solids larger than specified.

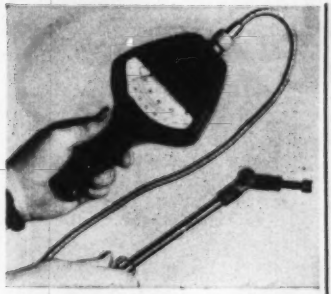
CUNO

Fluid Conditioning

Removes More Sizes of Solids from More Kinds of Fluids

Strain fuels, lubricants, process fluids, etc.—AUTO-KLEAN
Filter fuels, lubricants, process fluids, etc.—MICRO-KLEAN
Clean raw water, recirculating water, etc.—FLO-KLEAN

INSTRUMENTS PRODUCTION TESTING



New G-E Hand Pyrometer With Two Scale Ranges

Simply flick a switch to change scale ranges on General Electric's new Type FH-1 hand pyrometer. This unique feature in the new FH-1 cuts testing time, eliminates use of several pyrometers.

The Type FH-1 hand pyrometer is designed for rapid and convenient measurement of surface, liquid, gas and molten-metal temperatures.

THREE INTERCHANGEABLE TIPS

A surface tip, an immersion tip for liquids and molten metals, and a 2-prong contact are supplied with the FH-1. In addition, a carrying case and flexible and rigid arms are provided for the FH-1. Both tips and extension arms are interchangeable in seconds.

AUTOMATICALLY COMPENSATED

Readings can be made directly for either scale of the instrument. With automatic cold-end compensation the FH-1 needs no manual adjustment for variations in temperature in either the instrument or surrounding atmosphere.

STOCK SHIPMENT

See your nearest G-E representative today for complete information about immediate shipment on the FH-1, or check coupon at right for GEC-836. Price of FH-1 is $118.17*

B. F. Goodrich Co. Eliminates Arguments Over Finishes with G-E Roughness Scales

Obtains factory standards with two low priced scales

The Machinery Development Department of the B. F. Goodrich Company has standardized on the use of G-E roughness scales in specifying to machinists the metal finishes desired. Reports Mr. Fred Barnes, manager of the Department, "Our G-E surface roughness scales eliminate the old controversy over what the machinist thinks we want and what we actually have in mind. It gives us a primary advantage in fortifying our position with subcontractors."

"GETS RIGHT FINISH"

B. F. Goodrich maintains that the G-E surface roughness scales guarantee that the surfaces of a completed machine are the same as the design engineer intended.

"RECOMMENDS USE"

R. F. Cooper, head of drafting reported, "We regard G-E surface roughness scales very highly because they eliminate misunderstanding between B. F. Goodrich and subcontractors and assure uniformity of finishes. This makes possible the interchange of parts regardless

of manufacturer as long as the standard procedure is followed." Incorporated in the title block of the Machine Development Department's drawings is, "Finishes: G-E Surface Roughness Standards."

LOW PRICE

G-E surface roughness scales are composed of two small metal rules. One side of each scale is divided into 12 surfaces. These 24 surfaces are grouped into 10 degree surfaces. Low prices—the two G-E scales cost $18.33* together. Write for Bulletin GEC-774.

Portable Double Bridge Aids Acceptance Tests

MATERIALS ACCEPTANCE TESTS of magnanin wire, which is used for instrument shunts, are currently being aided by the General Electric portable double bridge.

Specifications for this wire list maximum acceptable specific resistance. This requirement is quickly checked for each length of wire by first measuring its dimensions and then using the double bridge to measure its resistance.

Designed for easy operation, the G-E portable double bridge has only one dial to adjust while making measurements. For maximum utility, it has eight ranges, measuring resistance values from 0.0001 to 22 ohms. For more information send coupon for Bulletin, GEC-251. Price: $304.20.*

*Manufacturers suggested price

1952 CATALOG

G-E Measuring Equipment

80 pages describing all of General Electric's testing and measuring devices. For free copy check GEC-1016 in coupon at right.

SECTION B605-14, GENERAL ELECTRIC
SCHENECTADY 5, N. Y.

Please send me the following bulletins:

Indicate:
√ for reference only
X for planning an immediate project

- ☐ Type FH-1 Hand Pyrometer GEC-836
- ☐ Surface Roughness Scales GEC-774
- ☐ Portable Double Bridge GEC-251
- ☐ 1952 Catalog GEC-1016

NAME .....
COMPANY .....
STREET .....
CITY ..... ZONE ..... STATE .....

GENERAL ELECTRIC

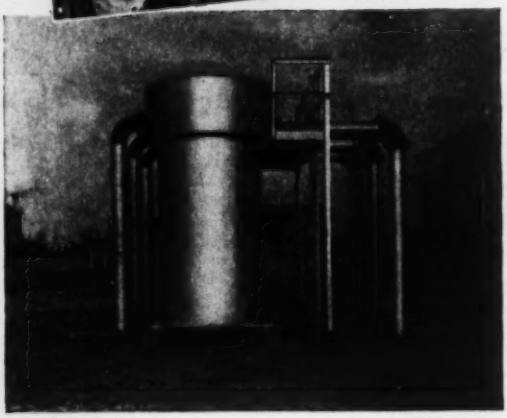
Dirty Water can't "Shut-down"...

Vogt

film type exchangers

(Condensers—Coolers—Evaporators)

Patent Nos. 1,935,270 - 2,057,597 - 2,424,441



River water, well water or brackish water are all alike to this exchanger *because it can be cleaned* while in operation! The water distributing ferrules need only be removed successively for the cleaning brush or tool whereby the tubes receive additional water which sluices away the dislodged dirt.

Vogt Film Type Exchangers are operating with real economy of first cost, operation and maintenance in power, petroleum, and chemical industries. They serve as Jacket Water Coolers, Feed Water Heaters, Hydrocarbon Evaporators, Sulphuric Acid Coolers, and Sulphur Dioxide Condensers, and can be designed to cool or heat any liquid and to condense or evaporate any fluid.

TOP: *Four units at Newton Falls, Ohio Municipal plant cool water for diesel engines and a lubricating oil cooler.*

BOTTOM: *Jacket Water Coolers serving engines of 7,500 HP in the compression plant of a Western Oil Refinery.*

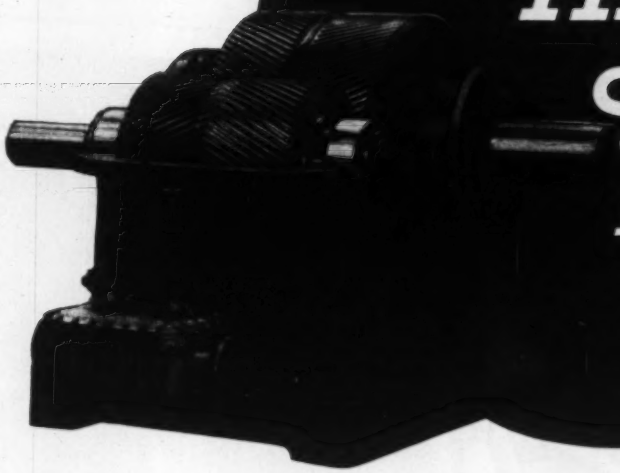
[Bulletin HE-7 describes typical installations of Vogt Film Type exchangers and is available upon request.]

HENRY VOGT MACHINE CO., LOUISVILLE, KY.

Branch Offices: NEW YORK, CHICAGO, CLEVELAND, DALLAS, PHILADELPHIA, ST. LOUIS, CHARLESTON, W. VA.

FOR TURBINE APPLICATIONS AND OTHER

HIGH SPEED DRIVES



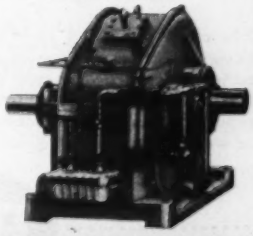
OUR "60" ANNIVERSARY

Philadelphia High Speed Units have been developed for applications where shaft speeds and pitch line velocities exceed the limit for standard parallel shaft gear units. A growing list of users indicate their satisfactory and dependable performance on turbine reduction drives to pumps and other machinery, also as speed increasers from low speed engines to high speed pumps or fans.

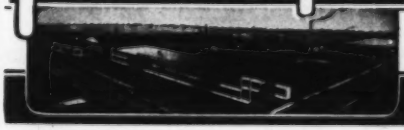
Gears are double-helical type, accurately cut and shaved to balance thrust reactions. Special high speed bearings keep gears in proper alignment. Lubrication is force-feed type. Heat generated in high speed operation is dissipated by a water-cooled heat exchanger. Balanced Gears combined with rigid bearing mountings keep noise and vibration to a minimum. Units available for complete range of speed and horsepower applications.

For full details send for our Bulletin 300.

Illustrations show open and closed views of typical drive designed to continuously transmit 1400 h.p. from a 3000 r.p.m. turbine to a 1200 r.p.m. pump.



Philadelphia Gear Works, INC.



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NEW YORK • PITTSBURGH • CHICAGO • HOUSTON • LYNCHBURG, VA.

Industrial Gears and Speed Reducers
LimiTorque Valve Controls

Are You

The chain habit is a good one to have when you're designing drives and conveyors. But *don't* be "chained" to just one particular type of chain. In the complete Chain Belt line there are literally hundreds of sizes and types of chain, each one designed to do a specific kind of work. Naturally, you want to select the chain that will perform most efficiently and economically over the longest period of time.

There's where your Chain Belt Field Sales Engineer can help you. You see, he is specially trained to study with you your chain selection problems. He can recommend from the complete Chain Belt line the one chain which will give the most satisfactory service in your

REX

BALDWIN-REX®

Chain

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CHICAGO • CINCINNATI • CLEVELAND • DALLAS
DENVER • DETROIT • EL PASO • HOUSTON
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"CHAINED" By Habit?

REX® CAST PINTLE CHAIN—for slower speed drive and conveyor service where long life due to greater bearing area is needed.

REX TABLETOP® CONVEYOR CHAIN—provides a smooth, steady surface for conveying bottles, jars, cans, etc. Simple, two-piece link and pin construction makes for easy maintenance.

BALDWIN-REX DOUBLE PITCH ROLLER CHAIN is an excellent drive or conveyor chain where light weight is important, and speeds and loads are low to moderate. *Not* a substitute for standard roller chain.

BALDWIN-REX® STANDARD ROLLER CHAIN—ideal for high speed drives and timing applications. A wide range of attachments is available for every type of conveyor service.

BALDWIN-REX LEAF CHAIN—an excellent chain for tension linkage applications where linear movement of the chain is not continuous in direction. Used on lift trucks, hoists, controls, etc.

REX CHABELCO® STEEL CHAIN—especially suited for operation where loads are heavy and conditions of dust, dirt, and grit are encountered. This chain can really take it

application. Illustrated here are just a few samples from our complete line. They are all quality chains built with over 60 years of chain-making experience behind them.

Next time you have a chain selection problem, why not call your nearest Chain Belt branch office; or if you prefer, just mail the coupon. Chain Belt Company, 4643 W. Greenfield Ave., Milwaukee 1, Wis.

Belt COMPANY
OF MILWAUKEE

MIDLAND, TEXAS • MILWAUKEE • MINNEAPOLIS
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PORTLAND, OREGON • SPRINGFIELD, MASS.
ST. LOUIS • SALT LAKE CITY • SAN FRANCISCO
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Chain Belt Company, 4765 W. Greenfield Avenue 52-104
Milwaukee 1, Wis.
Gentlemen:
I am particularly interested in chains for the following purposes:
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.....
Please send me appropriate literature.
Name.....
Address.....
City.....*State*.....

NOTES for the Power Engineer

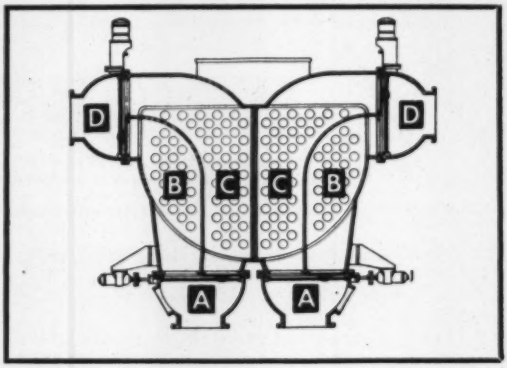
C.H. Wheeler OF PHILADELPHIA

STEAM CONDENSERS—STEAM JET EJECTORS—COOLING TOWERS—VACUUM REFRIGERATION—HIGH VACUUM
PROCESS EQUIPMENT—MICRO-PARTICLE REDUCTION MILLS—MARINE CONDENSERS & EJECTORS—DECK MACHINERY

"REVERSE FLOW" CONDENSERS

SOLVE YOUR CLEANING PROBLEMS—REDUCE OPERATING COSTS

These advantages are possible only in C. H. Wheeler's unique design of an integral reverse-flow steam condenser. By an arrangement of electrically or hydraulically controlled sluice gates, the flow of water through the condenser tubes is reversed. Refuse is rapidly and thoroughly flushed down the discharge in a matter of minutes, without shutdown of the unit. In addition to saving cleaning time and eliminating labor costs, you improve the efficiency of the whole unit by not reducing load. The need for expensive mechanical water straining apparatus is also eliminated. Reverse-Flow may be incorporated in either divided or non-divided water boxes.

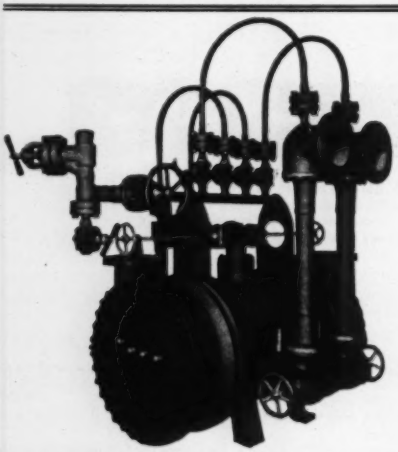


CROSS-SECTION DUAL BANK CONDENSER SHOWING HOW "REVERSE FLOW" WORKS

Both halves work the same but independently of each other.

Right Side: Water enters divided water box at valve chamber D, with lower port open. It flows through pass B to end of condenser, back through pass C and out through left port of A.

Left Side: Flow is reversed: Valves at inlet D and discharge A are changed to permit water to flow through C and back through B in the opposite direction, then out through lower port of A.



SPECIAL TYPE TUBEJET VACUUM PUMP FOR HIGH PRESSURE AND HIGH SUPERHEAT

"TUBEJET" VACUUM PUMPS INSURE LOWEST MAINTENANCE FOR YOUR STEAM CONDENSERS

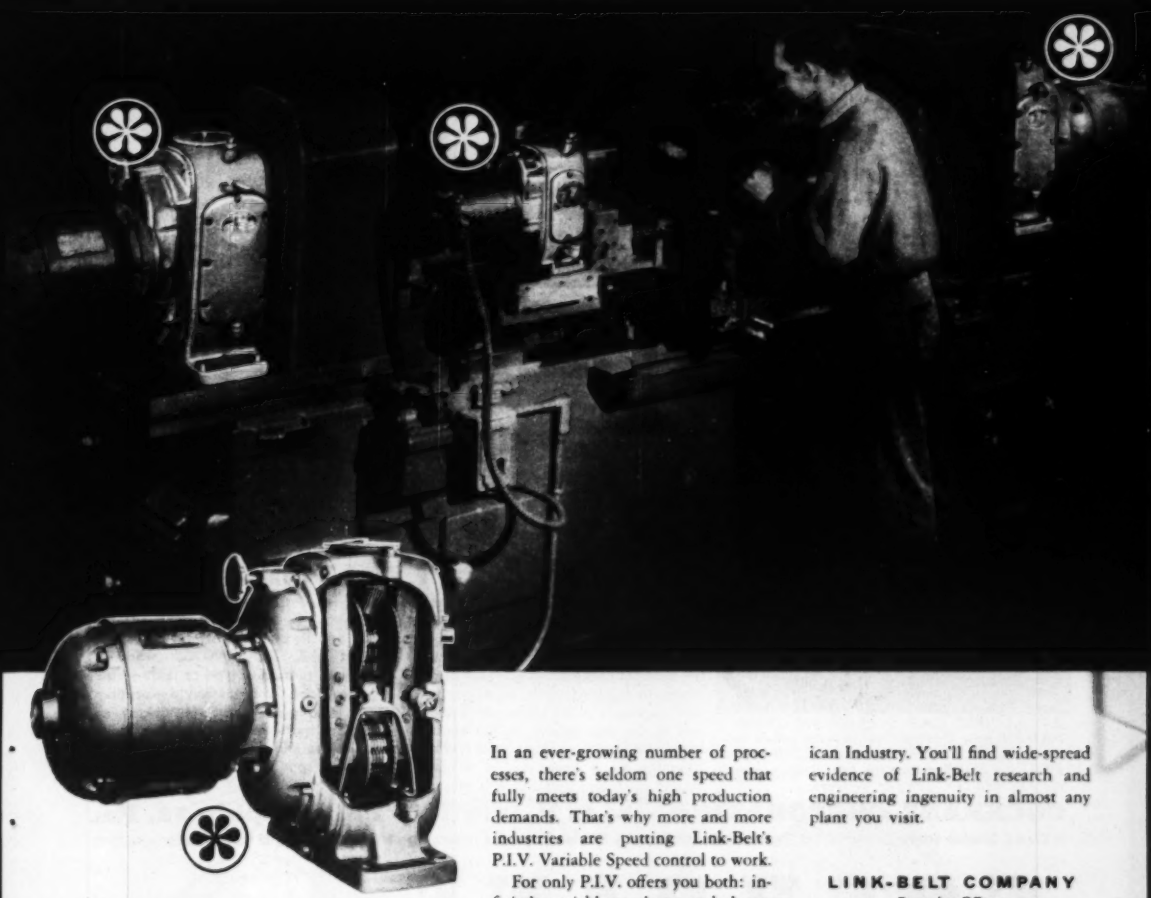
C. H. Wheeler Steam Jet Ejectors are the development of 35 years of pioneering in this field. Known as "Tubejets," these vacuum pumps have no moving parts. Hence, they are simple to operate, require almost no maintenance and last longer. Modern Power plants use single or two-stage Tubejets with surface inter-after condenser for the vacuum requirements of steam condensers. Special arrangements of standard Wheeler ejector assemblies can be provided for any unusual installation or performance requirements. Catalog #1462 gives you detailed descriptions and some useful temperature and pressure conversion tables. Write for it.

C. H. WHEELER MANUFACTURING CO., 19th & LEHIGH, PHILADELPHIA 32, PENNA.

Steam Condensers • Centrifugal, Axial and Mixed Flow Pumps • Steam Jet Ejectors • Cooling Towers • Vacuum Refrigeration
Process Equipment • Marine Pumps & Ejectors • Deck Machinery

LINK-BELT Research and Engineering . . . Working for Industry

Top Efficiency Achieved by Matching Speed and Need



Industry can vary machine speeds to fit the job—thanks to the amazing flexibility of LINK-BELT P.I.V. Variable Speed Drive

In an ever-growing number of processes, there's seldom one speed that fully meets today's high production demands. That's why more and more industries are putting Link-Belt's P.I.V. Variable Speed control to work.

For only P.I.V. offers you both: infinitely variable stepless speed changing *plus* positive chain-drive power transmission. You select the speed your work requires . . . get it quickly with manual or automatic control . . . then maintain it accurately through continuous or intermittent operation.

This is just one example of how Link-Belt has met the needs of American Industry. You'll find wide-spread evidence of Link-Belt research and engineering ingenuity in almost any plant you visit.

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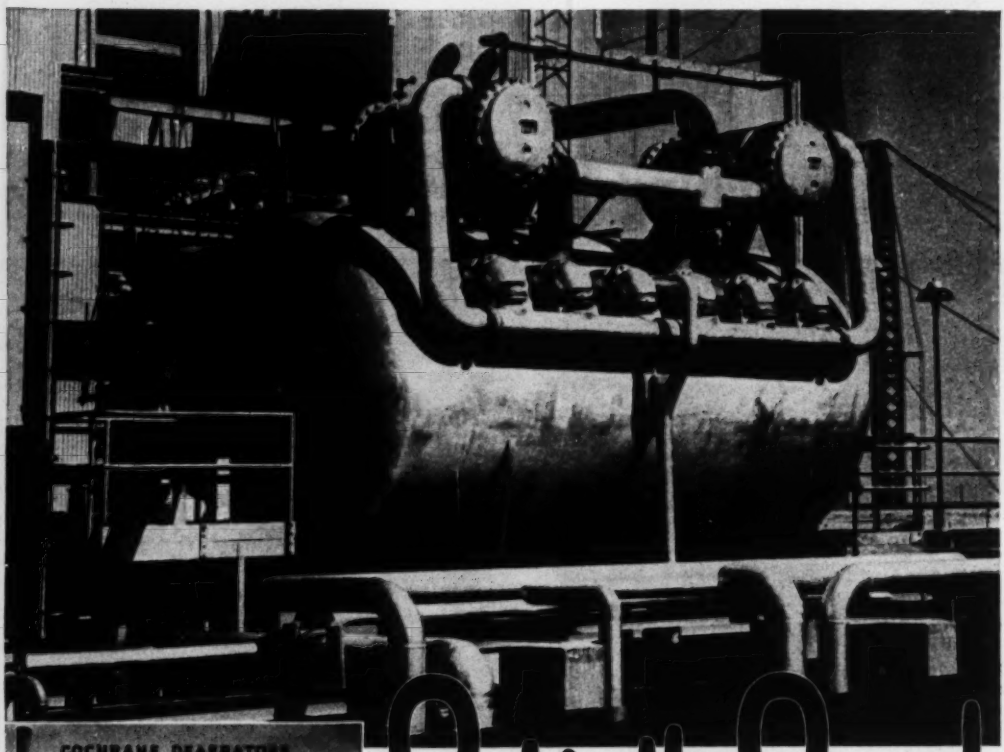
Executive Offices:
307 N. Michigan Ave., Chicago 1, Ill.

Plants: Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Houston 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8, Springs (South Africa), Sydney (Australia). Offices in Principal Cities. 12,751

LINK-BELT

ONE SOURCE . . . ONE RESPONSIBILITY FOR MATERIALS HANDLING AND POWER TRANSMISSION MACHINERY



Out in the Open!

AT PACIFIC GAS & ELECTRIC COMPANY'S new Contra Costa steam plant at Antioch, California, three COCHRANE DEAERATORS deaerate the boiler feed for six 475,000 lbs./hr. boilers.

Cochrane Deaerators at P. G. & E.'s Contra Costa Plant

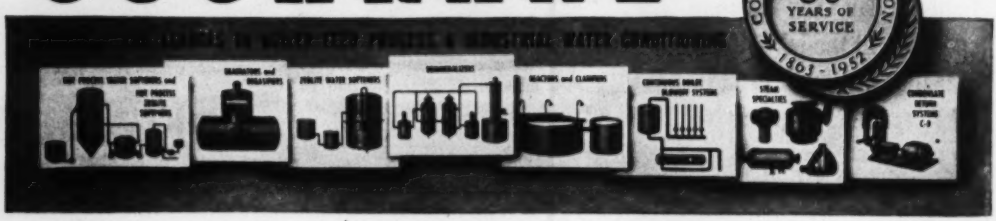
THE DEAERATORS are of the Cochrane direct contact tray type with 1,176,870 lbs./hr. maximum flow, and 6300 gal. storage capacity. Each deaerator has two vent condensers and all three deaerators are mounted on the auxiliary bay roof, as shown in the large photo above and in the inset panel. In the heating cycle, the Cochrane Deaerators function after the No. 5 closed heater at a designed operating pressure of 5 psig.

These deaerators are three of the fifteen Cochrane Deaerators purchased by P. G. and E., installed or now on order. COCHRANE DEAERATORS whether tray-type, atomizing type or multi-stage type, are available for any deaerating need, for any size plant and for any location or space requirement. Cochrane Publication No. 3005 will be gladly mailed on request. Specific problems are also welcomed.

COCHRANE CORPORATION • 3142 N. 17th St. • Philadelphia 32, Pa.

In Canada: Canadian General Electric Co., Ltd., Toronto • In Mexico: Babcock & Wilcox de Mexico, S. A., Mexico City • In Europe: Recuperation Thermique & Epuration, Paris

COCHRANE



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AIRCRAFT CORPORATION, GA. DIV., MARIETTA, GA.

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Aeronautical Electrical Mechanical

A New Opportunity, in a New Division, a New Location, working for an outstanding, long-established leader in commercial and military aviation. Top level jobs, increased pay, association with top men in your profession, New Opportunity for important personal achievement.

And off the job—gracious living for you and your family, modern housing, in beautiful North Georgia, with its traditional Southern charm, friendliness, educational and cultural advantages; its famous climate and year-round sports. Only 8 miles from Atlanta.

(If you prefer the West Coast, your application will be promptly forwarded to LOCKHEED at Burbank, Calif., where similar openings are available.)

CLIP AND MAIL TODAY!

Lockheed Employment Manager,
594½ Peachtree St., N.E.,
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Please send me full information on opportunities at LOCKHEED.

Name _____

Address _____

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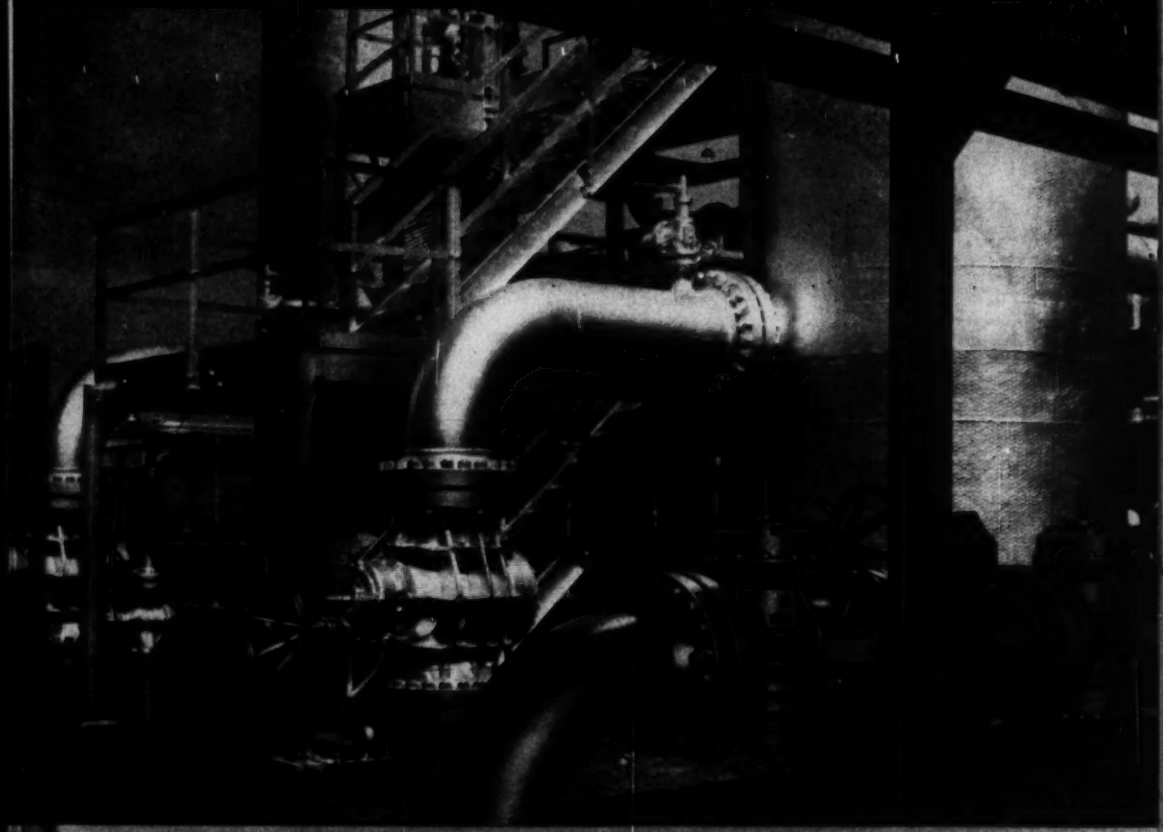
My Occupation (type of Engineer) _____

IT'S EASY TO FIT THE RIGHT



SPECIAL APPLICATIONS Henderson engineers can tell you what special valinery applications you can successfully make with Henderson valves.

INSIDE OR OUT The same characteristics that make Hendersons the most economical valves for general line conditions make them the best but an inside replacement lines.

ALL SIZES There's a Henderson valve in the right size, the right pressure class, the right material, the right end connection, and the right behaviour for nearly every ordinary or gasoline plant service.

VALVE TO

Gasoline Plant and Refinery Services

With the background of several hundred thousand Nordstrom valves in refinery service around the world, Nordstrom engineers can help you select the best, most efficient designs for each type of refinery operation.

Nordstrom valves are especially suitable for refinery lines. The extra seal of plastic lubricant around the seat port area protects seating surfaces against line fluid, and at the same time gives a hydraulic jacking action for easy opening where line conditions cause many valves to stick.

For nearly all complex, hard-to-control refinery line fluids there are suitable Nordstrom valves. These are typical Nordstrom services:

HANDLING HYDROCARBONS—Loading rack, marine terminals, general transfer and run-down lines and other applications throughout the refinery where light hydrocarbons are the line fluid.

CHEMICAL TREATING—Handling treating acids, caustic, Doctor Solution, copper chloride and other reagents, in continuous or batching processes. Special metals are available.

LUBE OIL TREATING—Selective solvent treating of lube oils, including treatment with phenol, etc., along with the deasphalting of oils with propane, methyl ethyl ketone and other methods.

REFINERY GASES—In unit operations or compressor plants, Nordstrom lubricant-sealed valves are generally preferred.

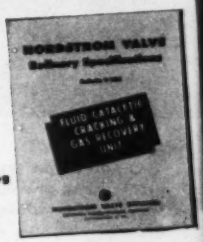
AVIATION GASOLINE PRODUCTION—Manufacture of alkylate for making high octane gasoline, either by the sulphuric acid process or anhydrous hydrofluoric acid process. Special metals, packings and flow area facings are available.

WATER SERVICES—Condenser service, water process lines and power plant lines.

AIR LINES—All types of air service lines.

PETRO-CHEMICAL MANUFACTURE—Examples: phthalic anhydride, isopropyl alcohol, synthetic glycerine, synthetic ethyl alcohol, napthenic acids and other petroleum based chemicals.

Now You Can Easily Fit Nordstrom Valves to the Specific Services in Your Specific Refining Process



So that refinery engineers can select the proper Nordstrom Valves for each service in the principal refining processes, a series of specification sheets showing recommended materials, pressure classes, lubricants and valve figure numbers has been prepared. There is a special Nordstrom Specification Bulletin for each of these processes:

- Catalytic Polymerization
- Crude Topping and Vacuum Distillation
- Cycleversion
- Delayed Coking
- Distillate Recovery in Cycling Plants
- Duo-Sol Solvent Extraction
- Fluid Catalytic Cracking and Gas Recovery
- Girbotol Process
- Houdriflow Catalytic Cracking and Gas Recovery
- Hydroforming Process
- Light Ends Fractionation
- Naphtha Polyforming
- Phenol Extraction
- Propane Deasphalting
- Propane Dewaxing
- Solexol Process
- Solvent Dewaxing
- Thermal Cracking
- Thermal Reforming

A Nordstrom service engineer will be glad to review these specification sheets with you. Call your nearest Rockwell office or write to Rockwell Manufacturing Company, 400 N. Lexington Ave., Pittsburgh 8, Pa.

EASY STARR ASSOCIATION Engineers Nordstrom Valves, with controls, geared or electric operation, you can standardize on them throughout the refinery or gasoline plant.

There's an oil field supply store with Nordstrom Valves and Nordstrom Service as close as your telephone.

Rockwell Built

Nordstrom Valves

Lubricant Sealed to Keep Upkeep Down

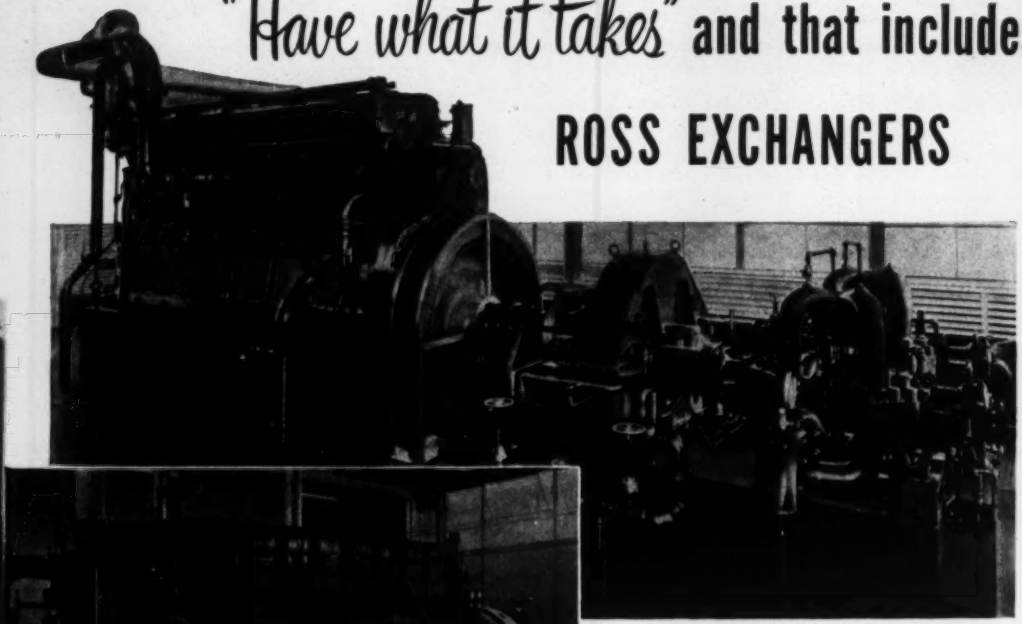
Another Rockwell *Product*

ROCKWELL MANUFACTURING COMPANY
400 N. Lexington Ave., Pittsburgh 8, Pa.

work-proved Cooper-Bessemer engines

"Have what it takes" and that includes

ROSS EXCHANGERS



Cooper-Bessemer JS, 8-cyl., 600 hp gas engine, equipped with Ross Exchangers (not shown), direct-connected to Farrel-Birmingham speed increaser (also Ross Exchanger equipped) on a West Coast crude oil line.

Two Cooper-Bessemer JS, 8-cyl., 688 hp Diesel engines, equipped with Ross Exchangers, driving generators in a Michigan utility.

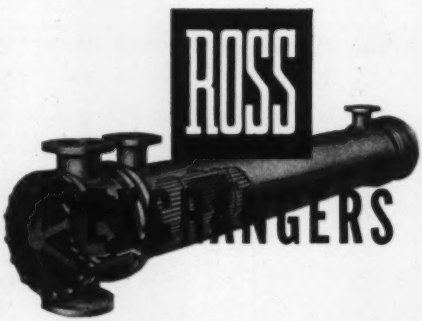
On oil or gas pipelines, in refineries or power generating plants, work-proved Cooper-Bessemer engines and compressors, in the words of their manufacturer, "have what it takes".

. . . and one of the very important things a Cooper-Bessemer Diesel or gas engine *must* have is efficient cooling. Lube oil and jacket water temperatures *must* be maintained at the correct level to assure the "Efficient Power at Lower Cost" which The Cooper-Bessemer Corporation promises.

That responsibility has largely been entrusted to Ross Exchangers. Performance-proved, pre-engineered, fully standardized . . . *they* "have what it takes", too, in the judgment of Cooper-Bessemer's design engineers and Cooper-Bessemer's customers alike.

For meeting *any* heat transfer requirement, there is no better means than furnishing a standardized Ross Exchanger as original equipment. Details in Ross Bulletin 2.1K1. Write.

Ross Heater & Mfg. Co., Inc., Division of American Radiator and Standard Sanitary Corp., 1448 West Avenue, Buffalo 13, N. Y. In Canada, Horton Steel Works, Limited, Fort Erie, Ont.



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TERRY

The rotor of a Terry Solid-wheel Turbine is a single forging of special composition steel. It is first rough turned in two operations, as illustrated, and then two cuts are taken to mill the semi-circular buckets from the solid metal. The wheel at the top has been finished, ready for mounting on the shaft. *The result is a single-piece wheel with no parts to loosen or work out.*

As the only function of the blades is to form a series of pockets, wear of the blades is of little consequence and does not materially affect the horsepower or efficiency. The important part of the bucket is the back, or bottom, which is a solid forging.

It is impossible for the blades to foul. They have large clearances, and are further protected by the projecting rims at the sides of the wheel. As the side clearances are also very large, end play can do no harm.

The Terry Solid-wheel Turbine is an extremely reliable piece of equipment. Why not write for complete details today?

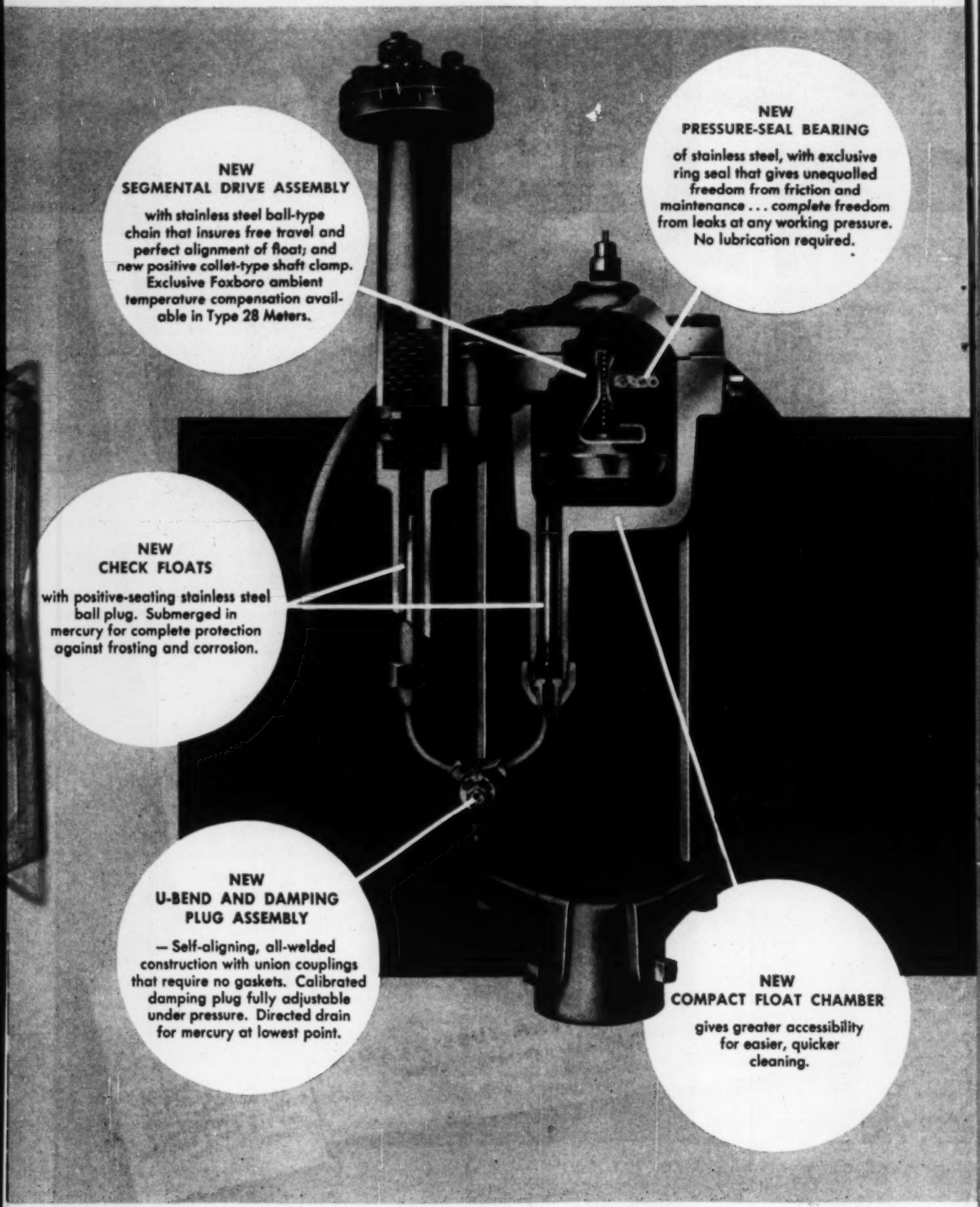
THE TERRY STEAM TURBINE CO.

TERRY SQUARE, HARTFORD 1, CONN.

TT-1188

Memo

Send for a copy of bulletin S-116 which describes the many advantages of the Terry Solid-wheel Turbine.


NEW
SEGMENTAL DRIVE ASSEMBLY
with stainless steel ball-type chain that insures free travel and perfect alignment of float; and new positive collet-type shaft clamp. Exclusive Foxboro ambient temperature compensation available in Type 28 Meters.
NEW
PRESSURE-SEAL BEARING
of stainless steel, with exclusive ring seal that gives unequalled freedom from friction and maintenance . . . complete freedom from leaks at any working pressure. No lubrication required.
NEW
CHECK FLOATS
with positive-seating stainless steel ball plug. Submerged in mercury for complete protection against frosting and corrosion.
NEW
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PLUG ASSEMBLY
— Self-aligning, all-welded construction with union couplings that require no gaskets. Calibrated damping plug fully adjustable under pressure. Directed drain for mercury at lowest point.
NEW
COMPACT FLOAT CHAMBER
gives greater accessibility for easier, quicker cleaning.

FACTORIES IN THE UNITED STATES, CANADA AND ENGLAND

New Basic Advances that Mean

BETTER METERING!

METERS FOR STEAM, GAS, LIQUIDS
Specifications

TYPE	MAX. W.P., PSI	RANGES
22	2000	20", 25", 50", 100"
26	5000	100", 200", 400"
27	2000	10", 20", 50", 80", 100" 200", 320", 400", 5"-0-5", 10"-0-10", 25"-0-25", 50"-0-50"
27U*	2000	100"
28	2000	50", 100", 200", 400"
29**	150	1", 2.5", 5", 10"

*Formed range chamber for uniform scale flow measurement

**Bell Type

With major improvements in every basic detail of differential meter design, the complete new line of Foxboro Flow Meters now gives, not only higher sustained accuracy, but also unprecedented ease of maintenance. It all adds up to metering performance that's farther ahead of the field than ever before!

In addition to the outstanding improvements illustrated, these new meters incorporate numerous other advanced features, including: interchangeability of all parts; large floats with long travel for added power; and location of floats in high pressure chamber to minimize ambient temperature effects.

Write for New Bulletin 460 containing detailed information on the design, construction and specifications of the new Foxboro Flow Meters . . . indicators, recorders, controllers and transmitters . . . round or rectangular cases . . . with or without integrators.

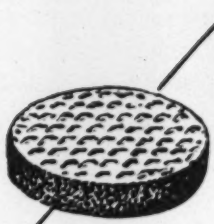
The Foxboro Company, 1825 Neponset Ave., Foxboro, Mass., U.S.A.

FOXBORO
REG. U. S. PAT. OFF.

SPONGEX CELLULAR RUBBER

Dams Water...Vents Air

in Ventmaster automatic valve for hot water heating systems



Uncompressed, this disc of Spongex cellular rubber forms an orifice of thousands of interconnecting cells which permit air to pass through the valve. Water, following the same path, causes companion hygroscopic discs to swell, compressing Spongex into a dam to shut off water flow. Heat from the radiator dries the hygroscopic discs; the Spongex cells open. Air again passes through the valve. This cycle continues year after year.

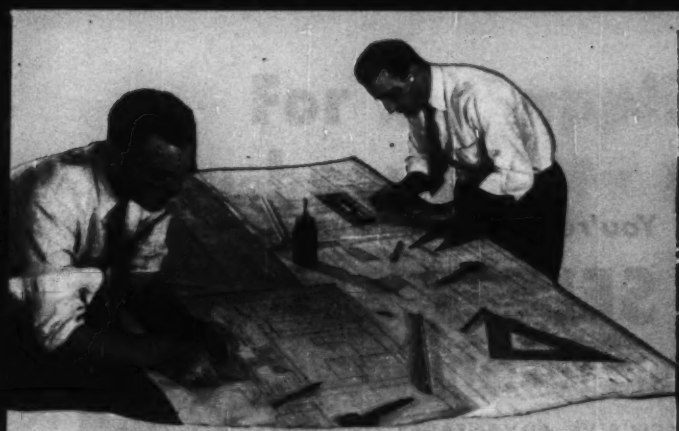
Unfailing compressibility under widely varying temperature changes, as required in this Ventmaster application, is an outstanding characteristic of Silicone Spongex. Even at — 100° F or 450° F, Silicone Spongex continues to function.

Years of specialization have developed a Spongex know-how with cellular rubber . . . its advantages and limitations under widely varying applications. We always are glad to have you draw on this experience for your cellular rubber needs.

SPONGEX® Cellular Rubber

used for cushioning, insulating, shock absorption, sound and vibration damping, gasketing, sealing, weatherstripping and dust proofing.

THE SPONGE RUBBER PRODUCTS COMPANY 501 Derby Place, Shelton, Conn.



The American Brass Company, Waterbury, Conn., reports

Plant layout speeded

with Kodagraph Autopositive Paper

THE engineering and drawing reproduction departments of The American Brass Company must keep pace with the constant plant-layout demands of ten manufacturing divisions. *And here's how Autopositive Paper saves time and dollars in this work.*

First, paper cutouts of machines and equipment are pasted in position on a whiteprint of the proposed layout. From this opaque pasteup, a positive reproduction on Autopositive Paper is made *directly*. There's no negative step, no darkroom handling with this revolutionary photographic intermediate material. Just exposure in a standard whiteprint machine . . . processing in standard photographic solutions.

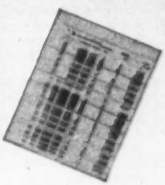
Then, the Autopositive intermediate—with dense photographic black lines on a durable, evenly translucent base—is used to produce the desired number of prints. These are sent to the branch involved to be studied and returned with comments.

This procedure may be repeated half a dozen times until complete agreement is reached on the final layout. And *every time* revolutionary Autopositive Paper saves time and dollars!

Other important uses of Kodagraph Autopositive Paper at American Brass

. . . to reproduce the blueprints and direct-process prints which the various divisions receive from vendors. The Autopositive intermediates are then used to produce any number of shop prints.

. . . to reclaim old, soiled, or worn drawings. Autopositive Paper intensifies line details . . . drops out smudges, creases—delivers intermediates which produce clean whiteprints and blueprints.



. . . to speed print service to all departments. Autopositive reproduces production reports, parts lists, documents of every type. And opaque originals can be copied as readily as translucent ones.

Kodagraph Autopositive Paper

"THE BIG NEW PLUS" in engineering drawing reproduction

Learn how Kodagraph Autopositive Paper is simplifying routines in thousands of concerns. Write today for a free copy of "New Short Cuts and Savings" for interesting facts about companies you know . . . and a revolutionary new product *you should know.*

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EASTMAN KODAK COMPANY, Industrial Photographic Division, Rochester 4, N. Y.

Gentlemen: Please send me a free copy of your new illustrated booklet, "New Short Cuts and Savings."

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16

Kodak
TRADE-MARK

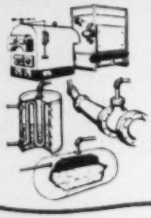
You're ahead 4 ways when you

SELECT SERVEL

AIR CONDITIONING EQUIPMENT

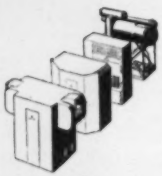
EXCLUSIVE ADVANTAGES OF SERVEL "ALL-YEAR" AIR CONDITIONING MAKE IT YOUR BEST BUY FOR TODAY—AND FOR THE YEARS AHEAD!

1 **Use existing steam lines to operate your Servel at low cost!**



Servel air conditioning units can be connected to your present source of steam to give you air conditioning at nominal cost. Servel "All-Year" Air Conditioners also operate on gas, oil, LP gas, waste heat, or steam from any source, at any pressure. With this multiplicity of fuels, Servel lets you use the most economical energy source.

2 **Servel has the model to do your job better!**

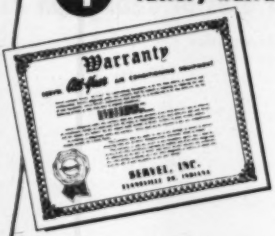


Do you have a problem in your plant that could be solved by the use of chilled water in one of your processes? Servel has the unit to remedy it! What do you want to air condition . . . a factory space, a store, an office? Servel has the unit or combination of units to provide economical air conditioning how and where you want it! You may have cooling only . . . a year 'round combination of heating and cooling . . . or combination units for vibration-free multiple floor air conditioning.

3 **Servel "no moving parts" design cuts maintenance costs!**

Operating on the famous absorption principle, Servel units deliver quiet, continuous, vibrationless operation at peak performance . . . year after year . . . and, because there is nothing in their cooling systems to wear out, require a minimum of maintenance! Operating within a vacuum—they are absolutely safe.

4 **Servel has a five year factory warranty!**



Servel's refrigeration unit is warranted for five full years! This warranty is your assurance of Servel quality and dependability.

SELECT SERVEL . . . the air conditioning that offers low operating costs, proven dependability, quiet vibrationless operation—and an exclusive 5-year warranty!

SELECT SERVEL . . . the air conditioning that offers low operating costs, guaranteed dependability in home, commercial or industrial installations.

Servel

AIR CONDITIONING

Made by the makers of the famous Servel Refrigerator

SERVEL, INC. • Evansville 20, Indiana

Write for the amazing cost-cutting facts about Servel Air Conditioning today!

Servel, Inc., Dept. ME-5, Evansville 20, Indiana

Gentlemen:

I'm interested in more information on Servel's new, low cost air conditioning. Rush me details on ( ) Industrial ( ) Commercial Air Conditioning.

Name _____

Firm _____

Address _____

City _____ *Zone* _____ *State* _____

For key applications on heavy-duty equipment

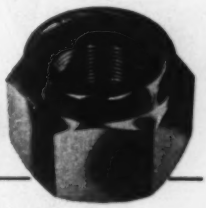
ENGINE MOUNTING . . . Powerful, high torque FWD engines are securely and dependably anchored with vibration-proof Elastic Stop Nuts. The Red Elastic Collar grips bolt threads firmly, withstanding the stress and shock of the most severe operating conditions . . . damping out even the most extreme vibration.

TRANSMISSION SEAL . . . Proper lubrication of heavy-duty working parts demands a tight seal, here assured by the application of Elastic Stop Nuts on this FWD transmission. The famous Red Elastic Collar seals against oil seepage.

CAB MOUNTING . . . With the rugged jobs that FWD trucks tackle, their powerful frames are subjected to severe stresses. Only a tough and tested self-locking device could be expected to remain tight—that's why FWD uses Elastic Stop Nuts on cab mounting bolts.

FWD TRUCKS

Four Wheel Drive uses *Elastic Stop* nuts



Uninterrupted service and minimum maintenance are vital to the customers of the Four Wheel Drive Auto Co., makers of special heavy-duty trucks. FWD is particularly conscious of the importance of unfailing bolted connections. They are using Elastic Stop Nuts at key points throughout their line, simplifying their own assembly as well as assuring better performance for their customers.

Resilient locking collars of nylon or fiber permit multiple reuse of Elastic Stop Nuts, and these self-locking fasteners have earned Army, Navy and Air Force approval. For design information on the wide variety of sizes, types and applications of Elastic Stop Nuts, contact your local representative—or mail this handy coupon.

ESNA

Elastic Stop Nut Corporation of America is also maker of ROLLPIN

ROLLPIN

Dept. N7-511, Elastic Stop Nut Corporation of America
2330 Vauxhall Road, Union, N. J.

Please send me the following free information on ESNA self-locking fasteners:

- ☐ AN-ESNA conversion chart
- ☐ Elastic Stop Nut Bulletin
- ☐ Rollpin bulletin and sample Rollpins
- ☐ Here is a drawing of our product. What self-locking fastener would you suggest?

Name _____ Title _____

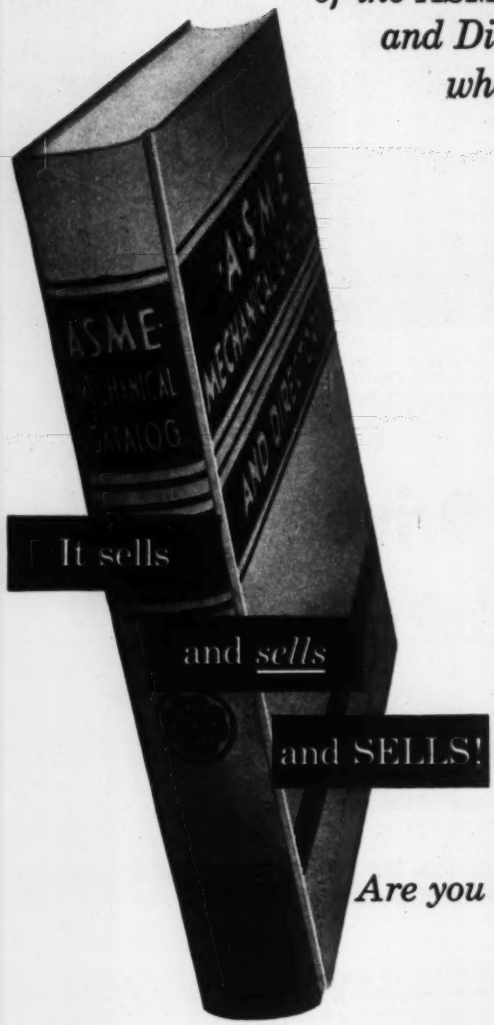
Firm _____

Street _____

City _____ Zone _____ State _____

ARE YOU A VENDOR AS WELL AS A VENDEE?

No one understands the selling power of the ASME MECHANICAL CATALOG *and Directory like the engineers who buy from it.*



That's why so many, who first used the Catalog for selecting and specifying products they wanted to *buy*, now use it for advertising products they want to *sell*.

In 41 years the ASME Catalog has taken its place as the No. 1 marketplace-in-print for the mechanical industries. Tens of millions of dollars of products and services that will be bought in the year beginning next October will be chosen directly from the

1953 ASME CATALOG

As nearly as can be estimated, between October 1952 through September 1953, the ASME Catalog will be consulted some 2,000,000 times by approximately 50,000 buyers and specifiers who will constantly refer to 15,000 copies of the Catalog.

That's why it is so important for every member of ASME, every reader of MECHANICAL ENGINEERING, who sells to the mechanical industries, to be *represented* in the next Catalog, and to make sure that what he offers *is fully described and illustrated.*

Our new creative Services Department will assist you with layouts and copy suggestions — at no charge.

The 1952-53 Catalog is now in preparation. It will go to press Monday, June 23. One page costs $405. With more pages used, the cost per page drops to as little as $162, for pages beyond 4.

Are you a Vendor, as well as a Vendee?

If you are, don't miss the next Catalog. There is no substitute. After June 23, you'll have to wait another year. Let us send you ENGINEERED INDUSTRIAL MARKETING, giving full particulars. Write to . . .

A-S-M-E MECHANICAL CATALOG and Directory

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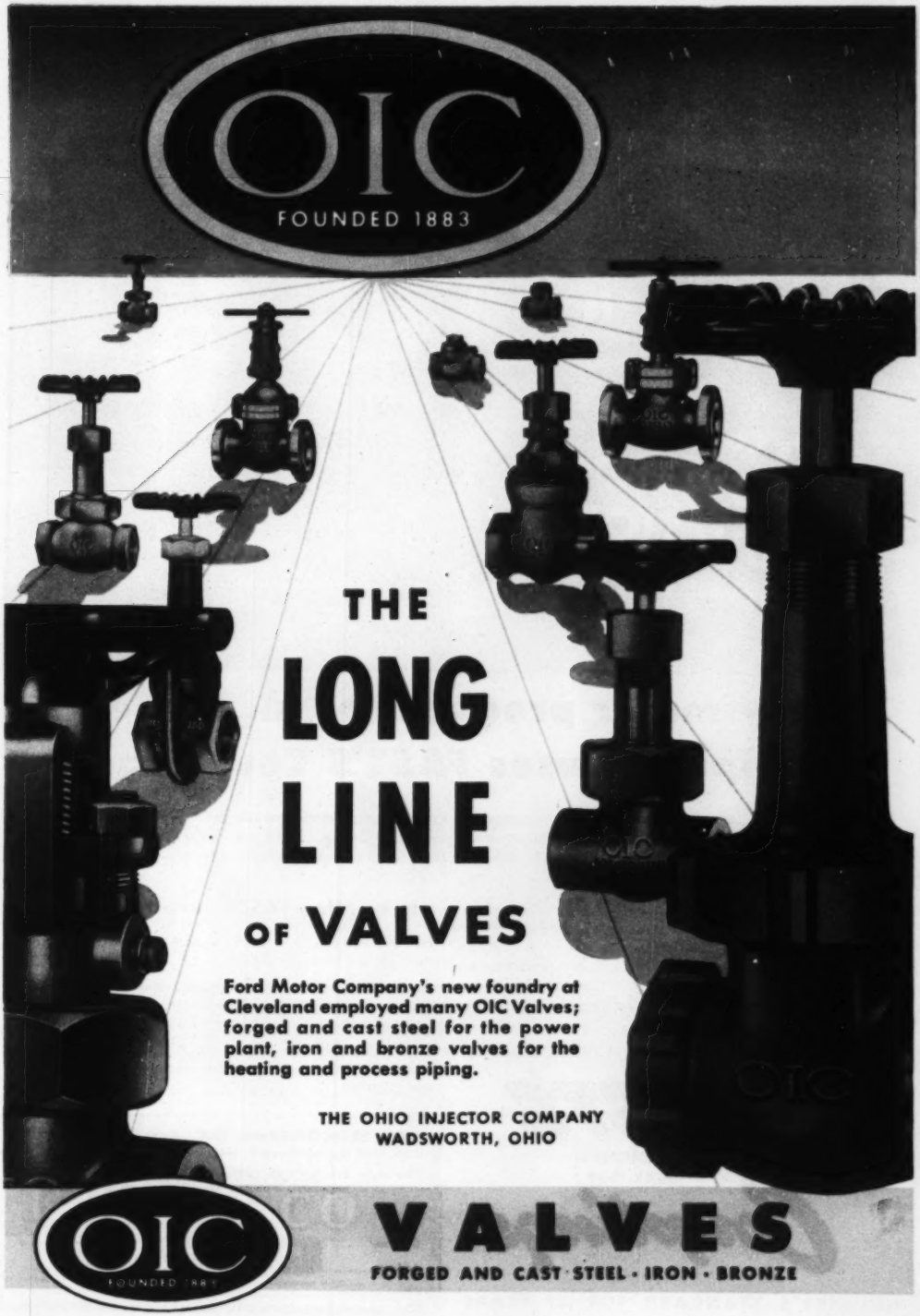
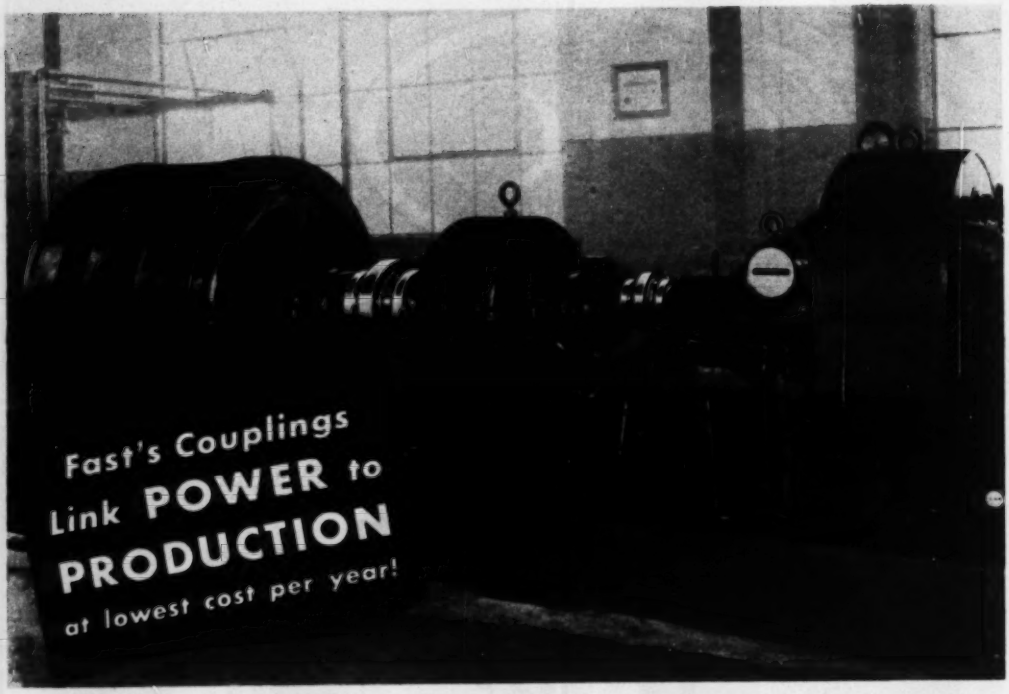

OIC
FOUNDED 1883
THE
LONG
LINE
OF VALVES
Ford Motor Company's new foundry at Cleveland employed many OIC Valves; forged and cast steel for the power plant, iron and bronze valves for the heating and process piping.
THE OHIO INJECTOR COMPANY
WADSWORTH, OHIO
OIC
FOUNDED 1883
VALVES
FORGED AND CAST STEEL · IRON · BRONZE



Every major producer of high-speed equipment uses FAST'S Couplings!

HIGH-SPEED equipment demands components with superior strength, accurate manufacture, long-lasting dependability. That's why it's important to *you* that Fast's Couplings are selected by every major high-speed equipment producer!

Fast's usually outlast the equipment they connect. Many have been in continuous operation for over 30 years, without trouble of any kind. And Fast's longer life saves you coupling dollars, too, because you amortize their cost over many years of trouble-free operation.

For full details on Fast's Couplings and Koppers Engineering Service, write today for your free copy of our catalog. Send to: KOPPERS COMPANY, INC., *Fast's Coupling Dept.*, 255 Scott St., Baltimore 3, Maryland.

KOPPERS

FAST'S
THE ORIGINAL
GEAR-TYPE
Couplings

INDUSTRY'S STANDARD FOR 32 YEARS

Here's How FAST'S Save You Money

Free Service—Koppers free engineering service assures you the right coupling for the job.

Rugged Construction—Fast's still maintains its original design, without basic change or sacrifice in size or materials. Result: freedom from expensive coupling failures.

Lowest Cost per Year—Fast's Couplings usually outlast equipment they connect. Their cost may be spread over many years!

KOPPERS COMPANY, INC., *Fast's Coupling Dept.*
255 Scott St., Baltimore 3, Md.

Gentlemen: Send me Fast's Catalog which gives detailed descriptions, engineering drawings, capacity tables and photographs.

Name _____

Company _____

Address _____

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LADISH

Controlled Quality

PIPE FITTINGS

reduce piping assembly time

Makeup goes smoother... with less chance for delay... on those piping systems where Ladish fittings are installed. Ladish Controlled Quality makes the difference. By exacting controls over materials and manufacturing processes... Controlled Quality assures uniform weldability through metallurgical integrity, fast assembly through dimensional accuracy and provides a real assurance of ultimate operating economy and complete dependability... reasons why it pays to specify LADISH.

THE COMPLETE *Controlled Quality* FITTINGS LINE
PRODUCED UNDER ONE ROOF...ONE RESPONSIBILITY

LADISH CO.

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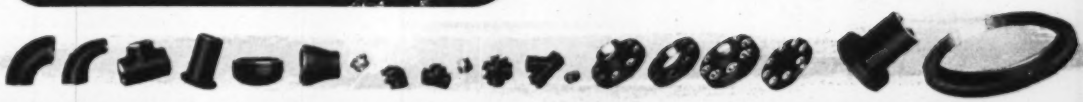
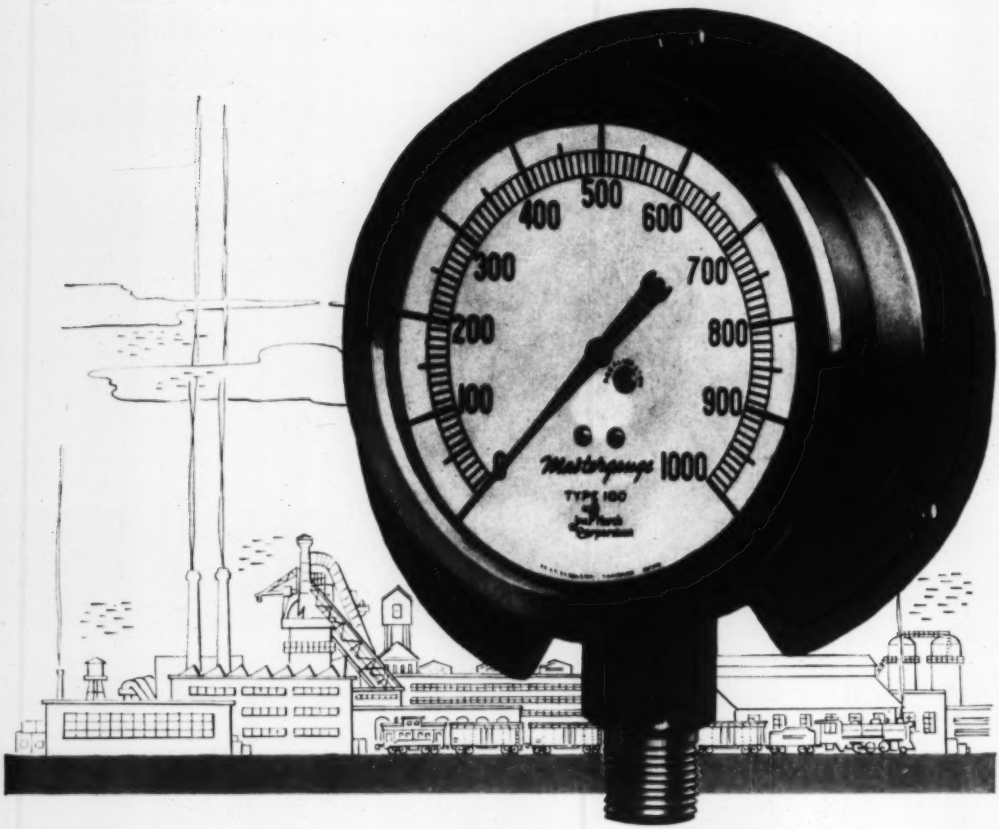




More than three quarters of a century beyond errors

Emerson said: "Experience is the label men give to their mistakes." That's a tough way to put it, but the fact remains that wise operating men show respect for this thought by searching out the products of manufacturers whose mistakes are largely *behind* them.

Ours are. While we frankly admit that we have made mistakes, we feel that we can conservatively and modestly say we are at least three quarters of a century beyond the mistake stage.

If you want further proof of this, look at the record of Marsh Gauges and Dial Thermometers. It is a record that has made Marsh instruments "The Standard of Accuracy" throughout industry.

Because Marsh instruments are so respected, they have been given top preference by the leading manufacturers of equipment requiring pressure gauges and dial thermometers. Marsh is the gauge on foremost makes of boilers, pumps, compressors and other products requiring pressure gauges.

Insist on Marsh gauges and thermometers throughout your plant. There is a type for every service.

The Gauge with the "RECALIBRATOR"

Not only the quickest way to correct a gauge; also the best. Best because it corrects for distortion of the bourdon tube — actually does *recalibrate* the gauge.

MARSH GAUGES

Marsh Instrument Co., *Sales affiliate of Jas. P. Marsh Corporation*
Dept. 29, Skokie, Ill. • *Export Dept., 115 E. 44th St., New York, N. Y.*

VICKERS HYDRAULICS

Help S-T-R-E-T-C-H DEFENSE DOLLARS

BATH CONTOUR FORMERS *produce* **Special Shapes at Lower Cost**

Special shapes for war planes and jet engines—of such metals as inconel, Haynes stellite, vanadium and titanium as well as aluminum alloys—are formed to a high degree of accuracy by cold stretching on the new Bath Contour Formers, having capacities from 12½ to 150 tons.

Vickers Vane Type Pumps furnish the hydraulic power for the clamps which grip each end of the work, and for the hydraulic cylinder which holds correct tension as the turntable revolves and the metal is stretch-formed. Vickers Valves assure correct tension and provide automatic overload protection . . . also easy and accurate control from the pulpit.

This is just one of many hundreds of ways in which Vickers Hydraulics improves operation and lowers cost. It is to the advantage of machinery builders to work with Vickers factory-trained application engineers who can cooperate effectively on the most complicated machinery. Get in touch with the Vickers office nearest you.

VICKERS Incorporated • 1500 OAKMAN BLVD. • DETROIT 32, MICHIGAN
DIVISION OF THE SPERRY CORPORATION

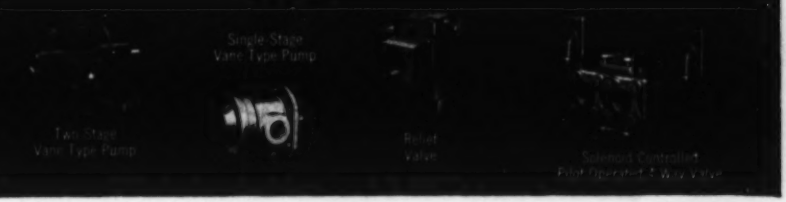
Application Engineering Offices: ATLANTA • CHICAGO (Metropolitan) • CINCINNATI • CLEVELAND • DETROIT HOUSTON • LOS ANGELES (Metropolitan) • NEW YORK (Metropolitan) • PHILADELPHIA • PITTSBURGH ROCHESTER • ROCKFORD • ST. LOUIS • SEATTLE • TULSA • WASHINGTON • WORCESTER

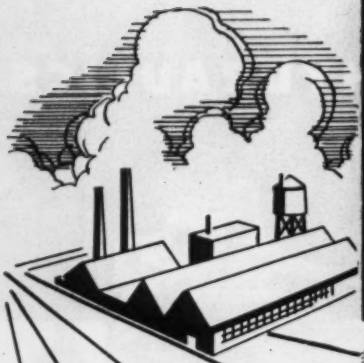
ENGINEERS AND BUILDERS OF OIL HYDRAULIC EQUIPMENT SINCE 1921

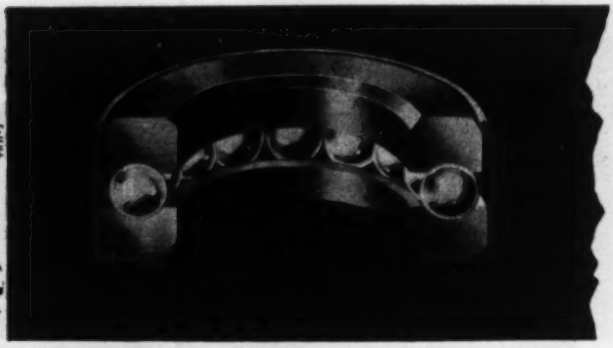
WRITE FOR A COPY OF CATALOG 5000

4762

Representative Vickers Hydraulic Pumps and Controls Used on Bath Contour Formers

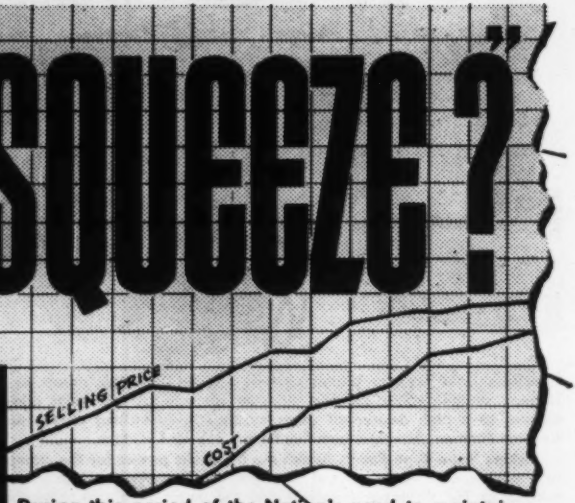


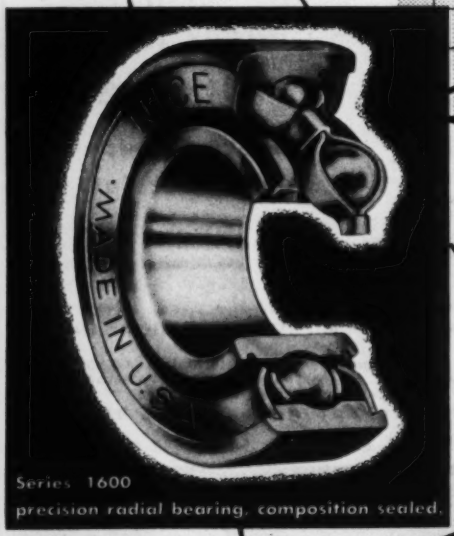




CAUGHT IN THE "SQUEEZE?"

Our 50th Anniversary
1902 - 1952





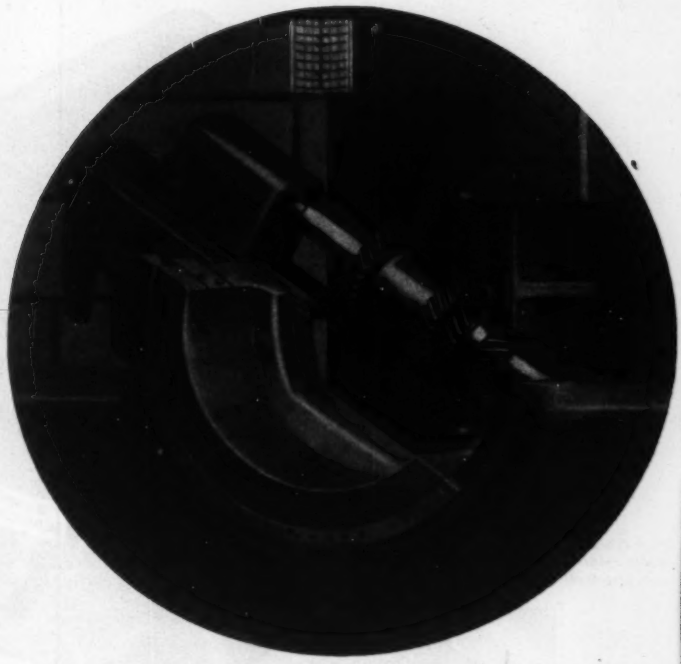
Series 1600
precision radial bearing, composition sealed.

During this period of the Nation's need to maintain a dual economy—production for the Defense Effort plus a percentage of civilian peacetime requirements, there can be no waste of either labor or materials. Especially is this true for the manufacturer "caught in the squeeze" between ceiling prices and still rising costs of material and labor.

Nice Ball Bearing Company produces complete lines of precision, semi-precision and unground ball bearings. Hence, NICE engineers can help solve your cost problems by designing or recommending the "exactly right" bearing for your particular application, *without sacrifice of product quality or performance.*

NICE

here's a practical way to check spur and helical gears



The Kodak Conju-Gage Gear Checker automatically records the composite effects of runout, base pitch error, tooth thickness variation, profile error, lead error, and lateral runout. Illustrated is the Kodak Conju-Gage Gear Checker, Model 4U, for gears up to 4½" pitch diameter. Larger and smaller models are also available.

In the final analysis, the accuracy of a gear is judged by whether or not it is good enough for the job.

Individual checks on errors such as profile error and pitch error can show tolerable variations which could combine to give a result intolerable in performance. Conversely, two intolerable errors might cancel out. But the composite check recommended in the American Standard (AGMA 236.02; ASA B6.11-1951) tests gears in action—tells at once whether or not the gear will do the job required.

With a Kodak Conju-Gage Gear Checker, you can check composite error to the closest tolerances. The reason lies in the Kodak Conju-Gage Worm Section. A single Worm Section, replacing a collection of master gears, can be used to check any spur or helical gear of any helix angle providing it has the same normal pitch and pressure angle. Its inherently simple and accurate form permits grinding to tolerances almost impossible to obtain in circular masters, especially in finer pitches.

Quick, conclusive, and accurate, the Kodak Conju-Gage Gear Checker makes it easy to meet specifications limiting tooth-to-tooth composite error to as little as .0002". It automatically writes records to hold or ship with finished gears. And the gaging element can be checked in your own toolroom—economically reground to original specifications if necessary.

To find out how the Kodak Conju-Gage Gear Checker can solve your precision inspection problems, send for the booklet, "Kodak Conju-Gage Gear Testing Principle." It's yours for the asking by writing to Eastman Kodak Company, Industrial Optical Sales Division, Rochester 4, N. Y.

CONJU-GAGE INSTRUMENTATION

. . . a new way to check gear precision in action

To inspect all kinds of complex parts on a bright screen, Kodak also makes two highly versatile contour projectors.

Kodak

WHAT *Life-Lines* REALLY DELIVER IS MORE SERVICE...LESS SERVICING

What *Life-Lines* really deliver is

...more service
...less servicing

"We can't afford equipment breakdowns. We manufacture ice cream making machinery and operate franchise stores throughout the country. Store operators know very little about maintenance. We *must* select equipment that assures trouble-free performance with minimum maintenance. That's what Life-Lines give us. That's why we standardize on them."

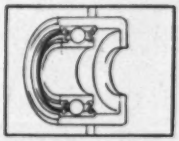
The above statement by the chief engineer of an eastern manufacturing plant tells the Life-Line story best. Summed up it means more service, less servicing with Life-Lines.

Take the Life-Linestarter®, for example. Contacts last longer because exclusive "De-ion®" arc extinction snuffs out arcs fast... reduces contact pitting. Simple seesaw balance of clapper prevents accidental opening; kickout spring prevents accidental closing. Compare with any other starter and see why Life-Linestarters offer *more service with less servicing.*

The Life-Line motor's advance design completely eliminates periodic lubrication. Pre-lubricated factory-sealed ball bearings need no greasing attention. Throw your grease guns away! Further, steel construction cuts breakage from rough usage. Superior insulation and winding techniques lengthen electrical life. On-the-job reports of a half million Life-Lines show why you get more service with less servicing.

It costs no more to get Life-Line performance. Ask your Westinghouse representative for details or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Penna.

J-21684



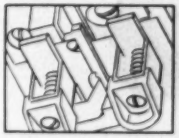
MOTOR

Needs no lubrication. Pre-lubricated factory-sealed bearings eliminate troubles due to under or overlubrication, dust and dirt.

Cuts winding burnouts. Pear-shaped slot design eliminates pockets. No corner voids remain to collect dirt, moisture.

STARTER

Never Jams. No sliding surfaces to wear—no sticking—no jamming—nothing to wear or replace.



Never needs filing. Silver-to-silver contacts eliminate filing. Discolored silver maintains high conductivity.

YOU CAN BE SURE...IF IT'S Westinghouse

Life-Line

MOTORS and CONTROLS

the STETSON is part of the man

JOHN B. STETSON COMPANY
PHILADELPHIA 22, PA.

Mr. C. C. Lucas
Howell Electric Motors
Broad Street Suburban Station
Philadelphia, Penna.

Dear Mr. Lucas:

It is not every day these days that a buyer can express his thanks and appreciation to a vendor for prompt compliance with scheduled delivery dates.

I want to do just that to you and, through you, to the Howell Electric Motors. While I am at it I wish to mention, also, that we are very pleased with the quality of workmanship and cleanness of design of your motors. Because our own product owes its national eminence to quality, we feel peculiarly fitted to recognize that standard in others.

With appreciation for your individual interest and the valuable cooperation of your factory, I remain

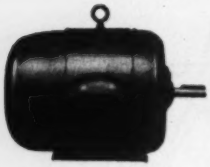
Yours very truly,

A. Kennedy, Jr.
Plant Engineer

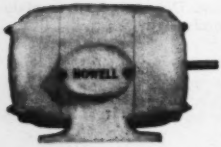
AKjr/sc

MORE PEOPLE WEAR STETSON HATS THAN ANY OTHER BRAND

HOWELL MOTORS are part of the STETSON



HOWELL Type K Motor. Offers constant performance in the presence of dirt, dust, fumes and moisture. Sizes from 3 to 150 H.P. at 1800 R.P.M. Either vertical or horizontal mounting.



HOWELL Sanitary Motors meet the most exacting standards of the dairy and food industries. They contain no pockets, cracks, or crevices. Available for vertical or horizontal mounting.

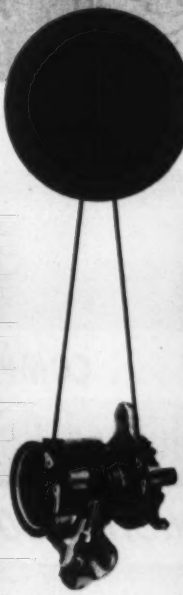
We think you, too, will appreciate Howell's attention to your electric motor problems. Howell engineers are always ready with technical assistance on motors in the standard NEMA frame sizes or with specially designed motors if your situation requires them.

So, on the tough jobs, on every job, consult Howell — manufacturers of industrial type motors from 1/6 to 200 H.P. since 1915. Contact the Howell representative in your city or write to us direct.

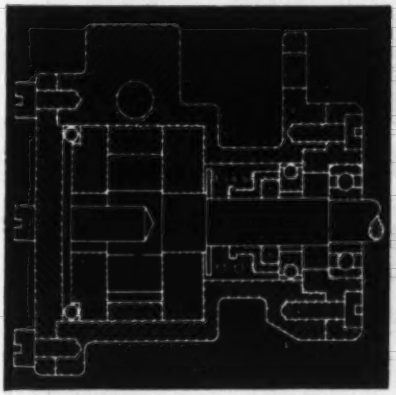
OWELL Red Band MOTORS

HOWELL ELECTRIC MOTORS CO., HOWELL, MICH.
Precision-built Industrial Motors Since 1915

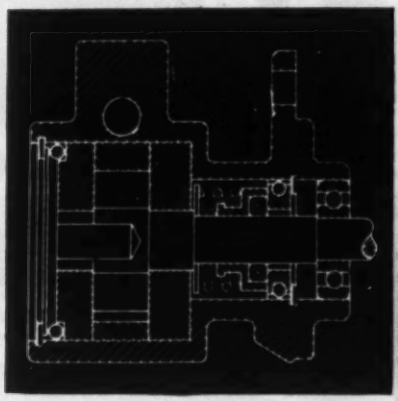
TWO TRUARC RINGS IN NEW PRESSURE PUMP SAVE $1.48 PER UNIT



OLD WAY Requires 4 skilled-labor threading operations...4 heavy screws on a cover plate and an internal tapped thread, plus plug at rear. Assembly is slow and difficult...maintenance necessary.



NEW WAY Just 2 Truarc Rings, set into accurately predetermined grooves, bring new simplicity of design... speedy assembly. No skilled-labor required! No maintenance! Rings lock parts accurately for life of unit.



Using 2 Waldes Truarc Retaining Rings in their new Pump, saved the Procon Pump & Engineering Co., Detroit, $1.48 per unit! With Truarc Rings, assembly is speedy, simple. Skilled-labor threading operations ...stripped threads...maintenance are eliminated. Parts are firmly held together for life of unit!

Redesign with Truarc Rings and you, too, will cut costs. Wherever you use machined shoulders, bolts, snap rings, cotter pins, there's a Waldes Truarc Retaining Ring designed to do a better job of holding parts together.

Truarc Rings are precision-engineered...quick and easy to assemble and disassemble. Always circular to give a never-failing grip. They can be used over and over again.

Find out what Truarc Rings can do for you. Send your blueprints to Waldes Truarc engineers for individual attention, without obligation. Waldes Truarc Retaining Rings are available for immediate delivery from stock, from leading ball bearing distributors throughout the country.

USE OF 2 WALDES TRUARC RINGS PERMITTED THESE BIG SAVINGS:

Eliminated 2 castings	$ .39
Eliminated 8 screws	.04
Eliminated machining of 2 castings	.56
Eliminated drilling and tapping housing	.40
Reduced assembly time by elimination of screws	.09
TOTAL SAVINGS	**$1.48**
Weight saved	14 ounces

For precision internal grooving and undercutting... Waldes Grooving Tool.

SEND FOR NEW BULLETINS ➡

WALDES TRUARC

REG. U. S. PAT. OFF.

RETAINING RINGS

WALDES KOHINOOR, INC., LONG ISLAND CITY 1, NEW YORK

WALDES TRUARC RETAINING RINGS AND PLIERS ARE PROTECTED BY ONE OR MORE OF THE FOLLOWING U. S. PATENTS: 2,382,947; 2,392,948; 2,419,852; 2,420,921; 2,429,341; 2,439,795; 2,441,846; 2,455,165; 2,493,390; 2,493,393; 2,497,902; 2,497,903; 2,491,306; 2,509,081 AND OTHER PATENTS PENDING.

Waldes Kohinoor, Inc., 47-16 Austel Place, L. I. C. 1, N. Y.
Please send engineering specifications and data on Waldes Truarc Retaining Ring types checked below. ME-054

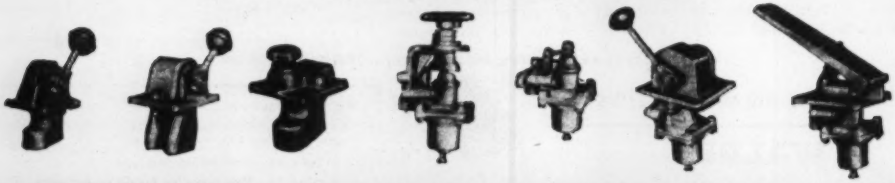
- ☐ Bulletin #5 Self-locking ring types
- ☐ Bulletin #6 Ring types for taking up end-play
- ☐ Bulletin #7 Ring types for radial assembly
- ☐ Bulletin #8 Basic type rings
- ☐ Send me information about the Waldes Grooving Tool.

Name_____
Title_____
Company_____
Business Address_____
City_____ Zone_____ State_____ 5678

The NEW . . . COMPLETE LINE of

8 PRODUCTION BOOSTING FEATURES

. . . and a complete range of modern pneumatic controls



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WESTINGHOUSE AIR BRAKE COMPANY
WILMERDING, PENNA.

Factory Branch: EMERYVILLE, CALIF. Distributors throughout the United States . . . Consult your Classified Directory. Distributed in Canada by: Canadian Westinghouse Co., Ltd., Hamilton, Ontario.

...when you want the best

When you want a motor for use in explosive atmospheres, you *always* look for the Underwriters' label—assurance that the motor is approved for operation in Class 1 Group D hazardous locations.

Fairbanks-Morse Explosion-Proof Motors carry that label—your assurance of motor safety under this class of hazardous conditions.

Every Fairbanks-Morse Motor carries still another label—another assurance that you are getting the best in motor performance and service.

That label of confidence is the Fairbanks-Morse Seal.

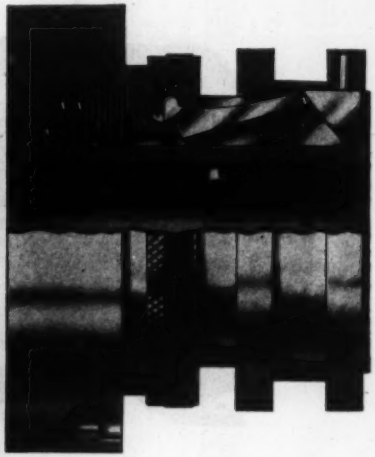
When you look for electric motors—for standard or unusual applications—*always* look for the Fairbanks-Morse Seal. For over 120 years it has stood for the finest in manufacturing integrity—to *all* industry. Fairbanks, Morse & Co., Chicago 5, Ill.

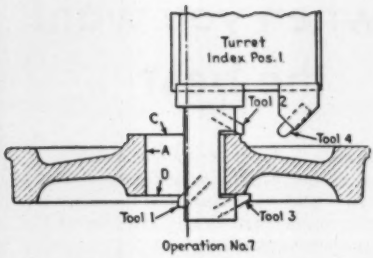
FAIRBANKS-MORSE,

a name worth remembering

ELECTRIC MOTORS AND GENERATORS • DIESEL LOCOMOTIVES AND ENGINES • PUMPS
SCALES • HOME WATER SERVICE EQUIPMENT • RAIL CARS • FARM MACHINERY • MAGNETOS

MAXITORQ





Turret index Position 1, the rough boring is performed. Tool set-up faces the hubs. (There are 4 index Positions.)

THE BULLARD COMPANY, outstanding machine tool manufacturer, selected Maxitorq floating disc Clutches for power transmission control in its famous Man-au-trol vertical lathe.

A Bullard engineer says, "Two No. 22 Maxitorq Clutches (see arrow) are used to automatically engage the cross-feed and down-feed drives for Angle Turning. In order to maintain accuracy, no slippage can be tolerated; the No. 22 Maxitorq Clutches are suitable for this application." In the job shown 12 carbide tools machine both sides of a Diesel engine wheel in 64 minutes, automatically. Former method required 4 hours.

If you have clutch problems look to Maxitorq... 8 standard sizes to 15 H.P. @ 100 r.p.m., wet or dry, single or double. Also in Automatic Overload Release type. All clutches manually adjusted, taken apart or assembled. Variety of special Driving Cups available. Complete engineering recommendations on request. Join our many "Good Company" users.

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THE CARLYLE JOHNSON MACHINE COMPANY
MANCHESTER • CONNECTICUT

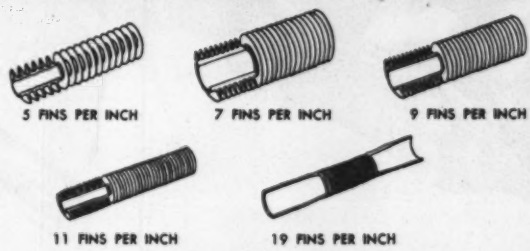
BCJ88

WOLVERINE TRUFIN*

offered in a

Wide Choice of Combinations

CHOICE OF THESE FIN SPACINGS



5 FINS PER INCH | 7 FINS PER INCH | 9 FINS PER INCH | 11 FINS PER INCH | 19 FINS PER INCH

CHOICE OF THESE METALS

Copper, copper base alloys, aluminum, or in bi-metal—having aluminum fins with liners of copper, copper base alloy, or steel.

CHOICE OF SIZES

Inside diameters from ¼" to 1" †

Outside diameters of fin from ½" to 2" nominal

†for further detailed information request Bulletin 651.

CHOICE OF THESE END TREATMENTS

(Available in 19 fins per inch)††

Full finned tube | Both ends plain†† | One end plain, other end stripped†† | Both ends stripped, including bi-metal††

††*Full finned end furnished in all sizes*

AS EASILY FABRICATED AS PLAIN TUBE

Trufin, the integral finned tube—can be fabricated as easily as plain tube—can be bent to unbelievably small radii to achieve extreme compactness. Trufin is suitable for nearly all kinds of heaters, coolers, interchangers, condensers and many other heat transfer applications. WOLVERINE TUBE DIVISION, Calumet and Hecla Consolidated Copper Company, Inc., Manufacturers of seamless, nonferrous tubing, 1437 Central Ave., Detroit 9, Mich.

*REG. U. S. PAT. OFF.

PLANTS IN DETROIT, MICHIGAN AND DECATUR, ALABAMA

Sales Offices in Principal Cities

Export Department, 13 E. 40th St., New York 16, N. Y.

Another important advance by MORSE!

Rollpin fasteners now available on five sizes of MORSE Roller Chains

Now, Morse gives you this tested, proved answer to cotter-pin failure in roller chains. It's the Rollpin, most reliable, longest-lived fastener ever incorporated into a power transmission chain.

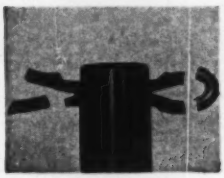
The Rollpin is a chamfered-end, heat-treated, slotted steel cylinder that is compressed into a pin hole smaller than the Rollpin's own diameter. The Rollpin expands and locks into place until deliberately removed by hammer and punch. It can't fatigue out even under the most severe working conditions.

The Rollpin is another outstanding example of Morse Roller Chain leadership that has already given you the benefits of shot peening and many other advanced metallurgical refinements.

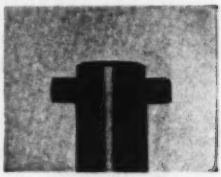
At no increase in price, Rollpin fasteners are currently available in most of the larger pitches of both standard and heavy-series Morse Roller Chains. If you have been experiencing cotter-pin failure, specify Morse Roller Chain *with Rollpins*. Standard cotter-pin chains are available and will be furnished unless otherwise specified.

M = PT Morse *means* Power Transmission

Rollpins outlast standard cotter pins more than ten to one!



Standard heat-treated cotter pin after only 3 hours on fatigue tester.



Rollpin after 50 hours on fatigue tester. It will outlast any other fastener on the market.

MORSE

MECHANICAL POWER TRANSMISSION PRODUCTS

BW

MORSE CHAIN COMPANY

Dept. 327, 7601 Central Ave. • Detroit 10, Michigan

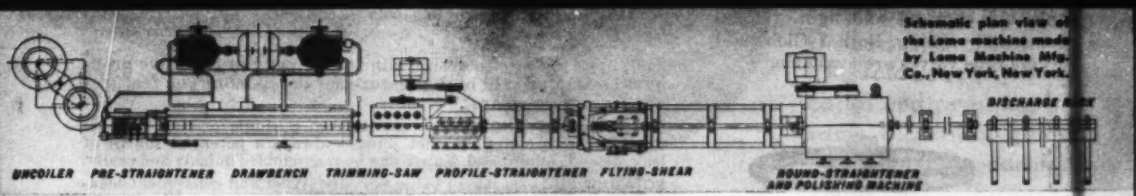
Amazing Lomatic Doubles and Triples Past Output

EMPLOYS

OILGEAR

AT CRUCIAL POINTS

Exit end of drawbench showing the twin Oilgear Fluid Power Pumps.



Schematic plan view of the Loma machine made by Loma Machine Mfg. Co., New York, New York.

AN unusual type of rod-processing machine produces finished stock at a rate two to three times faster than on conventional drawbenches or other types of continuous drawbenches. Drawing, straightening, shearing and polishing of brass rod are done in one operation on these Oilgear-equipped Lomatic machines.

Oilgear variable delivery pumps, cylinders and valves operate feed roll clamp to start rod through the pre-straightener. The Oilgear equipment provides synchronized operation in tandem and high-speed alternate drop-back in the draw carriage cycle. These functions are crucial to the successful operation of the Lomatic. The wonderfully smooth and steady drawing speed gained from Oilgear equipment means the production of uniformly high quality stock. The operator has full manual control of his machine for set-up and test purposes. He has remote pushbutton control of each carriage . . . and full automatic continuous operation. These superiorities result from the Oilgear simplified fluid power and control system.

Here is another outstanding achievement in machine design where Oilgear Fluid Power plays an important role in enabling the designer and builder to gain the requisite flexibility of application and control of power, simplicity of construction, engineering and installation, sturdiness, and built-in protection against overload.

You can do things with *this* power you ***CAN'T*** do with any other power . . . and you can do them ***BETTER*** with Oilgear Fluid Power equipment. What is your problem? Write THE OILGEAR COMPANY, 1570 W. Pierce Street, Milwaukee 4, Wisconsin.

Oilgear

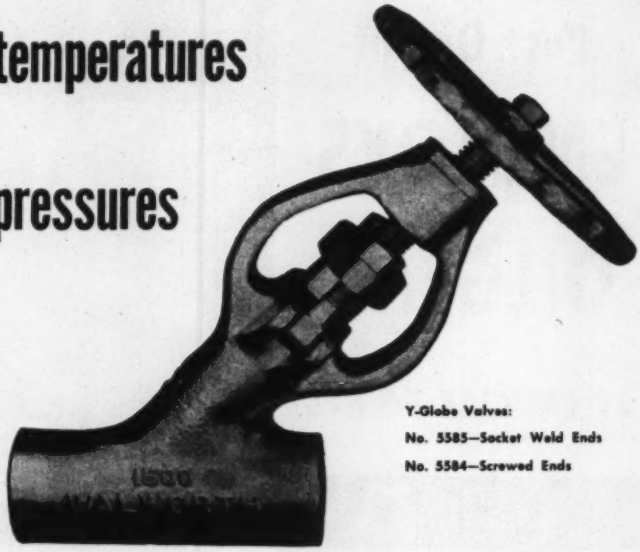
PIONEERS IN FLUID POWER

Pumps, Motors, Transmissions, Cylinders, and Valves

Walworth's NEW small cast steel valves

SERIES 1500 – SIZES ¼ to 2 inches

handle HIGH temperatures
HIGH pressures



Y-Globe Valves:
No. 5585—Socket Weld Ends
No. 5584—Screwed Ends

Walworth is proud to make these new Small Cast Steel Valves available to power stations . . . oil refineries . . . ships . . . wherever piping is subject to severe pressures and temperatures. Non-shock service ratings of these valves: 1500 psi–950F for steam; 3600 psi–100F for water, oil or gas. Cast of chromium molybdenum steel, they are compact and light, yet exceptionally strong. Both Y-Globe and Angle type valves are available.

Angle Valves:
No. 5587—
Socket Weld End
No. 5586—
Screwed End

Simplified Walworth design eliminates many of the valve problems encountered in high pressure service. Among the features of this new valve are:

INTEGRAL BODY AND YOKE – made from a single casting without threading or welding. Bonnet joint — always a potential source of leakage — is eliminated. Valves can be reassembled quickly and easily.

ROTATING DISC – prevents valve seat distortion and consequent leakage. Cuts down replacements.

WELDED SEAT RING – compensates for changes in pressure and temperature—eliminates a major source of leakage.

SPECIAL BACK SEAT BUSHING – permits repacking the valve under pressure with greater safety.

PACKING CHAMBER – designed to dissipate heat thus keeping packing rings at lower temperatures—gives them longer life.

These valves are available with either socket weld ends or screwed ends, in sizes ranging from ¼ to 2 inches. For further information on Walworth series 1500 Small Cast Steel Valves, see your local Walworth distributor, or write for Circular No. 134.

WALWORTH

valves • fittings • pipe wrenches

60 EAST 42nd STREET, NEW YORK 17, N. Y.

DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

Established 1888

D.O.James

CENTRALLY DRIVEN BALANCED DRIVE
With Great Emergency Strength

GEAR SPEED R·E·DUCERS

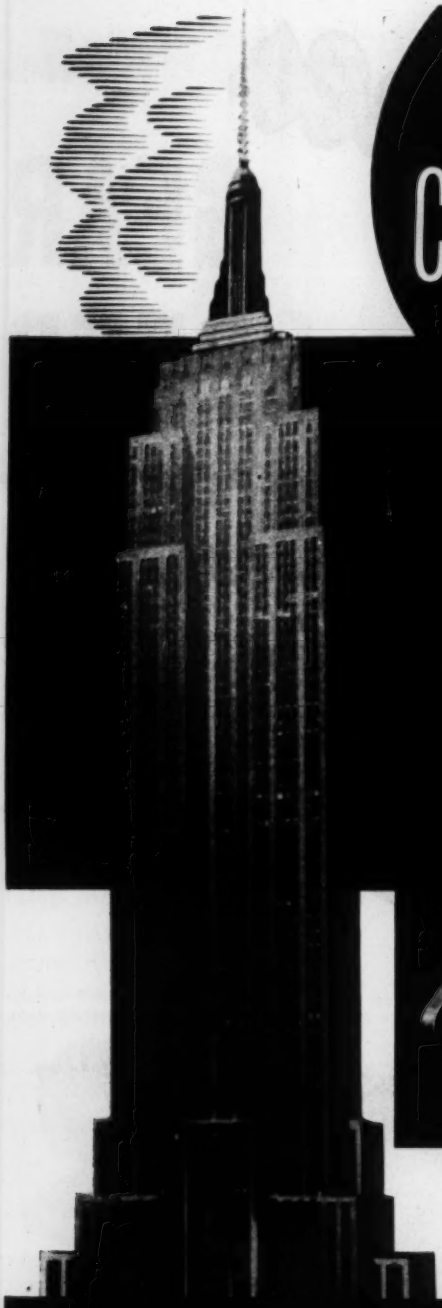
Multiple tooth engagement, low tooth stresses, with high load capacity and high wear factor. Gears are heat treated, shaved and crowned (Elliptoid), equally balanced and revolving in same direction, quiet operation, long gear life, and highest efficiency.

Catalogs are available containing complete engineering data.

D.O.JAMES GEAR MANUFACTURING CO.
1140 WEST MONROE STREET • CHICAGO 7, ILLINOIS

Air Conditioning

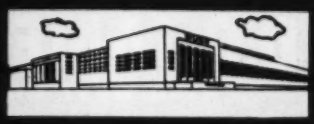
10 STORIES UP!



Quiet operation is all-important when you're conditioning office space 10 stories up (and going higher), as in the Empire State Building. With basement space at a premium, units must be located in conditioned areas. Naturally, noise is taboo. Bush horizontal air handling units provide the silent answer. Why not consider the Bush line in your next air conditioning problem. Catalog No. 425 contains complete specifications. Request copy on letterhead.

Consulting engineers for office areas in Empire State Bldg. conditioned by Bush units were Meyer, Strong & Jones. Contractors — York Distributors Inc., L. I. City, New York, and J. L. Murphy, Inc., New York City, N. Y.

Bush Manufacturing Company



There are many waterfalls but . . . *only one* Niagara

There are many coatings but . . . *only one* INSUL-MASTIC

INSUL-MASTIC pioneered heavy coatings—of *superior* quality. Years of thorough testing and experimentation, by corrosion plagued chemical companies, proved conclusively that long term protection against acids, alkalis and weather was at long last possible, through the use of INSUL-MASTIC.

The government confirmed this finding—INSUL-MASTIC being the only mastic coating ever approved under the original rigid specification for "mothballing" the war materiel.

INSUL-MASTIC *superior* coatings brought about changes in coating specifications throughout industry. The extremely long life and very low moisture vapor penetration rate of INSUL-MASTIC were the qualities that industry was seeking in its fight against corrosion and moisture penetration. The proven formulae which brought this enduring protection are patented and *cannot be duplicated* . . . there is only *one* INSUL-MASTIC.

Tests by the National Bureau of Standards and other impartial laboratories* prove the value of INSUL-MASTIC's basic ingredients for increasing coating life. Those ingredients are a maximum percentage of Gilsonite and *carefully* chosen mica and asbestos.

INSUL-MASTIC Vaporseal Coatings will prevent corrosion under severe chemical conditions, and will vaporseal insulation or building walls.

INSUL-MASTIC Type "D" Insulation will control condensation or prevent 65% of heat loss.

There is only *one* INSUL-MASTIC—Write for the name of our nearest licensee.

Think first of the coatings that last!

* *Names on request*

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INSUL-MASTIC
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CORROSION PROOFING
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Want to help build an atomic submarine? . . .
Design an atomic power plant?

START YOUR

LIFETIME CAREER IN ATOMIC POWER

at

Westinghouse

Westinghouse Atomic Power Division has a new plant in the outskirts of Pittsburgh. Laboratories are completely new. Equipment is right up to the minute.

The tools are here to explore atomic energy as a great source of power for transportation and industry. Opportunities for original work are almost without limit.

Westinghouse is now searching for the men who can use these tools and opportunities . . . who want to build a *life career* around atomic power work . . . who want to get in while this great new industry is still on the ground floor.

Here you will work with your kind of people. Every fourth person in the Division is an engineer or scientist. More than half the top Westinghouse executives are engineers. As the exciting new potentials of atomic energy reveal themselves, we expect the men we employ now to provide the nucleus around which this new division will expand.

ATOMIC POWER OPPORTUNITIES ARE WAITING NOW FOR MECHANICAL ENGINEERS WITH 4 TO 10 YEARS OF THIS KIND OF EXPERIENCE . . .

DESIGN OR APPLICATION—light and heavy structural supports for machinery . . . high pressure piping and systems . . . rotating machinery . . . steam turbines, general steam apparatus and steam power systems . . . heat exchangers and condensers . . . hydraulic apparatus and systems, fluid flow, systems evaluations, heat balance, valve design . . . mechanical and hydraulic devices and mechanisms (thorough knowledge of properties of materials required).

LIAISON—coordination with subcontractors and customers . . . scheduling and planning of ship trials and customer testing of nuclear powered steam plants.

SUPERVISION of drafting work.

SALARIES—Open. Westinghouse Atomic Power Division wants good men, and will go out of its way to make attractive offers to good men, based on experience and ability.

LOCATION—Approximately 12 miles south of Pittsburgh. No traffic problems if you live in this general area. Many homes available and under construction. Good shopping in suburban area.

MANY EXTRAS—IN ADDITION TO GOOD PAY! INVESTIGATE!

- Help in finding suitable housing
- We pay interview expenses
- Low cost life, sickness and accident insurance with hospital and surgical benefits
- Modern pension plan
- Opportunity to acquire Westinghouse stock at favorable prices
- Privilege of buying Westinghouse Appliances at discount

HOW TO APPLY—These Westinghouse Atomic Power Division opportunities are not the kind that can be handled in a routine fashion. From the very beginning, you will be in communication with top executives of the Division. Address your application letter to

MR. C. LYNN, Manager of Engineering
Atomic Power Division
WESTINGHOUSE ELECTRIC CORPORATION
P.O. Box 1468
Pittsburgh 30, Pa.

What Mr. Lynn, and other executives who will scrutinize your application want to know is: Where and when you obtained your degree . . . how you did in school . . . where you have worked at your profession . . . what kind of work you have done.

In other words, right now we're more interested in your ability to fill current openings and to develop in the Westinghouse Atomic Power Division than we are in your vital statistics. Write your letter of application accordingly.

You will be in communication with men who are experienced in keeping secrets. All negotiations will be discreet, and *your reply will be kept strictly confidential. Write to Mr. Lynn today.*

SUPERIOR CRAFTSMANSHIP
"The craftsmanship on your large gear is of the finest that I have ever seen."
A New York foundry
HELP IN A TIGHT SPOT
"Many thanks for shipping the six mitre gears. It is always good to know that we can get them when we're in a tight spot."
A Connecticut machine company
DELIVERY BEAT PROMISE
"The merchandise (gears) was excellent: the delivery better than promised; the price was right."
A Wisconsin water systems accessory manufacturer
OUTSTANDING SERVICE
"It is service such as this that places you high on the list as a source for gears and sprockets."
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HELPED CUSTOMER OUT OF JAM
"We wish to thank you for your very satisfactory service. You helped our customer out of a bad jam and we both are grateful to you."
A Chicago machine company

Here's what they're saying about Illinois Gear & Machine Company...

THESE are excerpts from a few of many unsolicited letters sent to us by customers. They tell you the standard of quality, the type of service, the kind of satisfaction you can expect from Illinois Gear. For a prompt answer to your needs, write today.

Gears for Every Purpose ... one gear or 10,000 or more

ILLINOIS GEAR & MACHINE COMPANY

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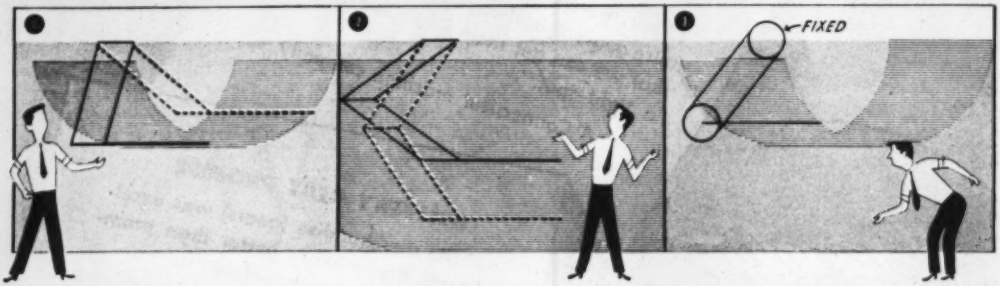


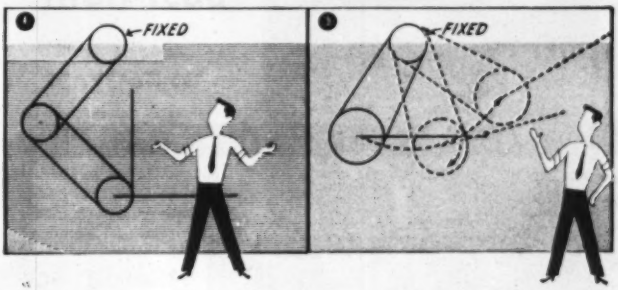
Start with a parallelogram somewhat like this. Visualize one of its short sides anchored to the top of a drawing board parallel to your base line, and let the remaining three sides be free to move together. Add a projecting straightedge to the bottom side as shown, and it will theoretically stay parallel to the base line. Parallel lines could be drawn anywhere within the shaded area above. But clearly, that field of action is too limited.

To obtain parallel motion over the entire working surface of the board, a second parallelogram could be coupled to the bottom of the first so that both have one short side in common. An elementary drafting machine would result . . . at least in principle. In practice, it would fall short because the slightest play at any of its 8 joints would create gross error at the straightedge.

What is needed is a better mechanical design based on the same parallelogram principle. Take a pair of rotating drums, connect them with a tight steel band, and the assembly will behave like a parallelogram if the drum diameters are equal. Now couple a second band-and-drum assembly to the first in such a way that they have the middle drum in common . . . and you have the basis of a modern drafting machine.

BETTER!"

The Right Angle



The band-and-drum machine, with all three drums of precisely equal diameters and with bands which will not slip, will draw absolutely parallel lines over the entire working area. But if the drum diameters are not equal, the parallelogram principle is violated and the machine cannot draw parallel lines. The greater the difference in diameter the more the lines will be out of parallel.

Here, in exaggerated form, is what happens when two of the drums are not equal in diameter. This could occur in either arm of the machine, conceivably in both arms with the errors being additive. From this it is clear that a central factor in the accuracy of a drafting machine is the accuracy of all drum diameters. That is why K&E goes to very extraordinary lengths in this regard in building PARAGON Drafting Machines.

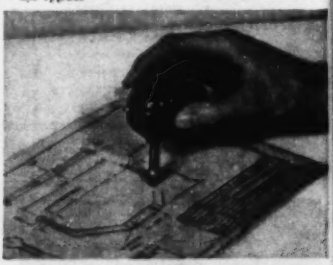
These basic principles and the advanced engineering design in the PARAGON combine to give you the finest in drafting machines. You realize this as soon as you place your hand on the controls.

The scales rotate freely with the lightest pressure on the protractor control ring. Release it and they are locked at the nearest 15° position. Intermediate angles are easily set.

Another PARAGON feature is the open center construction of the arms. Even when they are twisted by lifting the head of the instrument off the board, it is impossible to disturb the factory-set band tension.

Ask your K&E Distributor or Branch to tell you about other PARAGON features or give you an actual demonstration.

An engineer without a K&E Slide Rule is like a doctor without a stethoscope. It's the badge of the profession . . . with good reason. The first American-made slide rule was a K&E, and generations have known these rules for their precision, readability and velvet-smooth operation. They come in all types.



After you've once used a K&E MOTO-RASER,† you'd no more go back to hand erasing than you'd take to drawing with your gloves on. With MOTORASER you can either pin-point your objective, or cover a larger area without damage to the drawing surface. Runs on 110 volt 60 cycle AC, or DC with an inexpensive adapter.

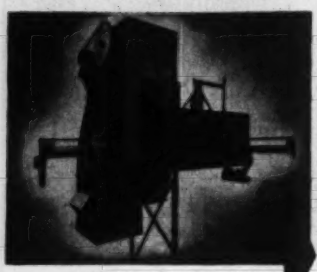
†TRADE MARK

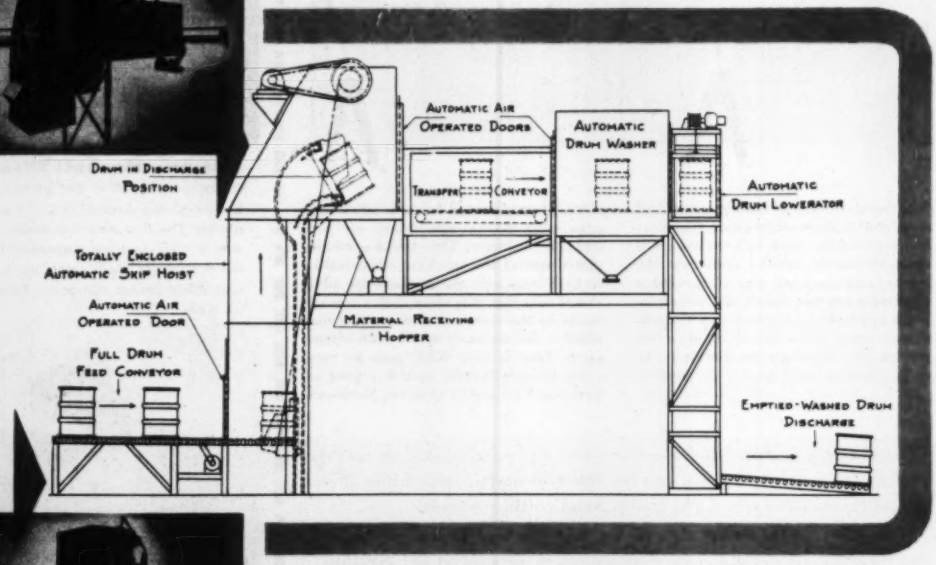
K+E

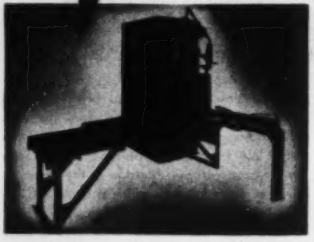
only through Engineering...
...can efficiency be achieved

G-W DRUM HANDLING SYSTEM

FULLY AUTOMATIC
TOTALLY ENCLOSED
DUST TIGHT







Call upon G-W Materials-Handling Engineers to survey your present methods; you are under no obligation. It might well prove to be a step toward higher profits through lower operating and maintenance costs.

Faced with an ever-increasing bottleneck in drum handling, a large eastern manufacturer placed his problem in the hands of Gifford-Wood's Materials-Handling Engineers. The result was the fully automatic system shown in the drawing. This dust-tight, fully enclosed installation now handles drums at the rate of 30 to 40 drums per hour.

The cover of the full drum is removed at a point on the feed conveyor. The full drum is then elevated and inverted, pouring the contents over a vibrating grate into the receiving hopper. Carried on a transfer conveyor to the automatic washer, the drum is cleaned, then lowered to the discharge conveyor.

This is just one of many examples of how G-W materials handling know-how achieved efficiency through engineering — efficiency in this case reflected in automatic handling at a greatly increased rate, with elimination of waste and maximum safety — all at greatly reduced cost.

When You Think of Materials Handling—Think of **GIFFORD-WOOD CO.**

Since 1814 • Hudson, New York

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8404

New KAISER ALUMINUM Plant USES 224 "Buffalo" FANS

FOR DIESEL SCAVENGING

80 of these extremely compact high pressure "Buffalo" Blowers supply scavenging air to the radial Diesels in the giant new Kaiser Aluminum plant at Chalmette, Louisiana.

FOR EXHAUST—

Sixty-four 100-inch "Buffalo" MW Exhausters serve on pot line exhaust at the new plant. Powered by 75 h.p., 1200 rpm motors, they have heavy plate housings and wheels to resist abrasion.

FOR FRESH AIR SUPPLY—

Eighty 54-inch "Buffalo" Tubeaxial Fans supply fresh air quietly and efficiently. These fans require a minimum of space, and have cast aluminum wheels.

BUILT FOR HIGH PRESSURES!

Heavy, ribbed cast iron housings and welded steel wheels mean efficient performance at high air velocities and pressures, in "Buffalo" Scavenging Blowers.

Send Your AIR PROBLEM TO "BUFFALO"!

Hundreds of business leaders like Kaiser Aluminum are relying on "Buffalo" Fans and Air Conditioning Units for plant-wide comfort, and the 1001 other jobs air does for industry. What is your air problem? There's a "Buffalo" Fan to solve it. Let us mail you details.

"Buffalo" FIRST FOR FANS

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PUBLISHERS OF "FAN ENGINEERING" HANDBOOK

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FORCED DRAFT COOLING HEATING PRESSURE BLOWING

R-S valvEvents

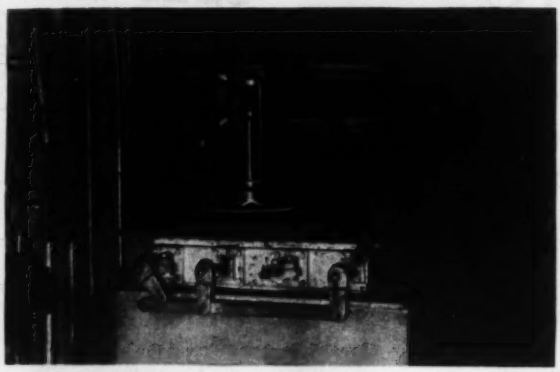
• EXCERPTS FROM THE R-S BOOK OF EXPERIENCE •

WATER SERVICE—No. 825—36-inch 125-pound cast iron valve equipped with 18—8 shafts, bronze bushings and rubber seat for 85-pound drip tight shut-off.

EMERGENCY OIL SERVICE—No. 628—solenoid trip valve. Should the solenoid function, the latch is tripped which causes the counter-weight to open or close the valve by gravity. Available in any metal or alloy and in various sizes for emergency shut-off or vent for air, gas, steam, oil, and water.

700° F. EXHAUST GAS SERVICE—No. 826—6-inch 125-pound R-S "H" metal valve used on small turbine generator. Equipped with 18—8 shafts, hastelloy bushings, finned lubricated stuffing box and solenoid trip mechanism.

STEAM SERVICE—No. 677—1500-pound welding end steel valve for superheated steam—A. S. M. E. Standards.



SEMI-SOLID SERVICE including abrasive and corrosive materials.

R-S VALVES
Control and Shut Off Practically Any Material

The beveled vane seats firmly at a 12½° angle and is closed from a fully open position through 77½° of arc by either manual or automatic operation. A metal-to-metal seat gives satisfactory commercial shut-off. When required, Monel or stainless steel can be welded to the vane periphery and a babbitted seat used in the valve body. Drip tight or bubble tight closure can be obtained with a rubber seat.

Power controlled prime movers delivering the necessary foot pounds of torque open or close these self-cleaning valves at any desired speed from one second to eight minutes according to requirements. Pressures range from 2 to 2500 psig and temperatures from minus 300° F. to plus 2000° F.

Such simplicity of design, adaptability and operating ease are the reasons why R-S Valves can be installed to control and shut off the volume and pressure of any material that flows or is forced through a pipe.

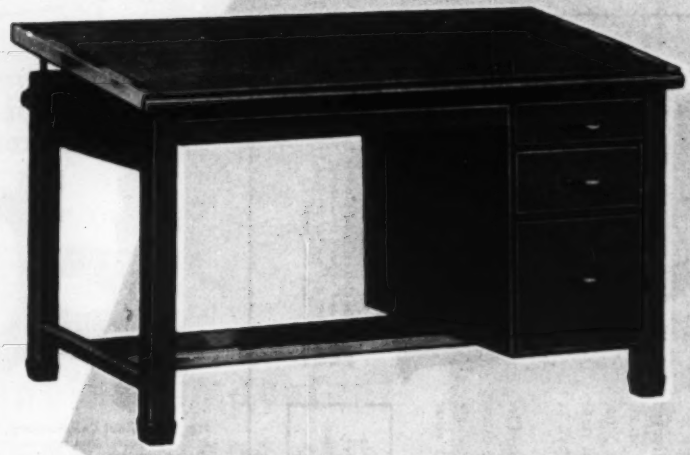
Obtain full details from your R-S representative.

R-S PRODUCTS CORPORATION
4600 Germantown Avenue, Philadelphia 44, Pa.
An S. Morgan Smith Company Subsidiary

DISTRICT OFFICES IN PRINCIPAL CITIES

Hamilton *Steelwood* Drawing Tables

remarkable 4-post tables with the lifetime strength of steel!



If you want a 4-post table tough enough to stay absolutely rigid, absolutely true, through years and years of hard service—you'll want to know more about Hamilton *Steelwood* tables.

The entire base of the *Steelwood* is made of heavy-gauge furniture steel, welded for permanent rigidity. A smooth-operating, *concealed* raising mechanism adjusts the expertly seasoned softwood drawing surface up to 42°. Zinc plated steel end-cleats keep the top true and accurate. Four top sizes and three drawer arrangements insure perfect tailoring of the *Steelwood* to your own requirements.

If drawing tables are a part of your responsibility, you owe it to yourself to learn more about the Hamilton *Steelwood*. These outstanding tables are available on a remarkably prompt delivery schedule. For complete ordering information see your Hamilton Dealer or use the handy coupon provided below.

HAMILTON WORK-DESIGNED DRAFTING EQUIPMENT

Please send me complete information on Hamilton Steelwood Tables.

Name_____

Position_____

Firm_____

Address_____ Zone_____

City_____ State_____

Hamilton Manufacturing Company

TWO RIVERS, WISCONSIN

NEW LINCOLN PLANT CREATED BY INCENTIVE-INSPIRED CO-ACTION IN DEVELOPING POSSIBILITIES IN PRODUCT

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WELDED DESIGN IMPROVES APPEARANCE

. . . while cutting costs 50%

BY converting to welded steel, this progressive manufacturer has achieved a more modern, better selling appearance for his products. At the same time he has cut costs 50% on some components.

Pleasing appearance in a product generally indicates efficient use of materials in its design. With welded steel, cumbersome and often costly dead weight, inherent with gray iron, is essentially eliminated. Wall thicknesses in steel are of exact design size. In addition, steel can be shaped at low cost with simple shop equipment.

While attaining stronger, more rigid products, in addition to improved appearance, savings in materials alone often run as high as 85%. Your Lincoln representative can show you how to apply the cost-saving benefits of steel to your products. Call or write.

Incentive Management—A thought-provoking approach to developing greater teamwork between employee and employer. Written by James F. Lincoln. Price only $1.00 postpaid in the U.S.A.; $1.50 elsewhere.

Fig. 3. Steel-Designed Blower *built by The Beardman Company, Oklahoma City, Oklahoma. Eliminates milling and drilling operations . . . is easier to clean and paint.*

PROPER DESIGN IN WELDED STEEL ALWAYS IMPROVES PRODUCT AND LOWERS COST

Fig. 1. Original Construction. *Required 41% more metal than present welded steel design. Heavier weight with gray iron added to handling costs in shop, in shipping and final installation.*

Fig. 2. Present Weldesign in Steel. *Saves 50% on cost. Has better appearance . . . greater selling appeal. Is stronger . . . more rigid.*

HERE'S MORE PROOF

Machine Design Sheets are available to designers and engineers. Write on your letterhead to Dept. 402,

THE LINCOLN ELECTRIC COMPANY

CLEVELAND 17, OHIO

The World's Largest Manufacturer of Arc Welding Equipment

Single Motor Drive

A single motor (air or electric) both rotates and propels the long lance tube

Another important advantage of DIAMOND Model IK Long Retracting Blowers

A single motor, simultaneously propelling the carriage and rotating the lance tube through a rugged system of gears, represents the ultimate in simplicity and reliability. There is only one set of motor elements, one set of control elements, and one set of power supply facilities to operate and to maintain. This feature of the Model IK Blower is an excellent example of the Diamond policy of simplification that means more dependable operation and lower maintenance costs.

Another feature of the Model IK that has the enthusiastic approval of users is the mechanically operated valve. Opening and closing of the valve is positive, dependable and accurate . . . all essential to correct performance. Here again note the simplicity of the mechanism.

For further information, ask for a copy of Bulletin 1055AA.

DIAMOND POWER SPECIALTY CORP.
LANCASTER, OHIO
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SURFACE ROUGHNESS STANDARDS

PHYSICAL SPECIMENS OF SURFACE ROUGHNESS AND LAY—In this new American Standard specifications are given for (1) the surface contour, material, accuracy, uniformity and rating of **precision reference specimens** used for checking the calibration of instruments for measuring surface roughness, and (2) **surface finish specimens** intended to illustrate commonly used machined surfaces.

B46.2-1952 $1.00*

SURFACE ROUGHNESS, WAVINESS AND LAY—Concerned with the geometrical irregularities of surfaces of solid materials, this Standard establishes definite classifications for various degrees of roughness, waviness and several varieties of lay. The ranges for roughness and waviness are divided into a number of steps, and the general types of lay are established by type characteristics. The Standard also provides a set of symbols for use on drawings and in specifications, reports, etc.

B46.1-1947 45¢*

SQUARE AND HEXAGON BOLTS AND NUTS

To modernize this Standard, numerous changes have been made in dimensions, tolerances, nomenclature and general specifications. For instance: With exception of the heavy bolts, head dimensions of all series of hexagon bolts and cap screws have been simplified by selecting as basic former across flats dimensions of the automotive hexagon head bolts or cap screws for sizes up to and including $^{9}/_{16}$ inch size and former across flats dimensions of the regular hexagon bolts for bolts $^{5}/_{8}$ inch size and larger, and by predicating the head height on a ratio of $^{5}/_{8}$ of the size diameter. Light and regular series nuts have been consolidated by selection of the dimensional proportions of the light series for sizes up to and including $^{5}/_{8}$ inch and dimensional proportions of the regular series for sizes above $^{5}/_{8}$ inch, with the exception of the $^{7}/_{16}$ inch which is a modification of the light and regular series. Sizes on which agreement has been reached with the British and Canadian Standardization groups are shown in bold type in the Standard's dimensional tables.

B18.2-1952 $2.00*

GLOSSARY OF TERMS IN NUCLEAR SCIENCE AND TECHNOLOGY

This Glossary represents coordination and extension of work started several years ago by scientific and national societies, trade associations and government organizations. Completed and published to date are the sections giving the terms used in the following fields:

III Reactor Engineering 75¢*
IV Chemistry 60¢*
V Chemical Engineering 60¢*
VI Biophysics and Radiobiology 60¢*
VII Instrumentation $1.00*
VIII & IX Isotopes Separation and Metallurgy $1.20*

In each of these sections are the terms peculiar to its field, those used in the field in a different sense or with different emphasis from what is most commonly understood in other connections, and terms used elsewhere in the same way but so infrequently as to be unfamiliar. Each section also includes an alphabetical listing of the terms to all sections.

1951-1952 STANDARDS ON PIPE FLANGES AND PIPE FITTINGS

MALLEABLE IRON SCREWED FITTINGS, 150 LB.—Covers dimensions and tolerances, pressure ratings, size, and method of designating openings of reducing fittings, marking and threading.

B16.3-1951 $1.00*

MALLEABLE IRON SCREWED FITTINGS, 300 LB.—Gives the approved dimensions for fittings in sizes $^{1}/_{4}$ to 3 inches inclusive, also the requirements for pressure rating, marking, material, tolerances and threading.

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STEEL BUTT-WELDING FITTINGS—Over-all dimensions, tolerances, and markings for wrought, cast carbon-and alloy-steel welding fittings in sizes 1 to 24 inches are here given. Supplementary tables give dimensions of welded and seamless steel pipe listed by Scheduled Numbers and as standard wall, extra strong wall, and double extra strong wall.

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NON-METALLIC GASKETS FOR PIPE FLANGES—In addition to providing dimensions and tolerances, this new Standard recommends the material, and gives the formulas for determining the diameters of gaskets for flanged joints having plain, raised, male, female, tongue and groove facings.

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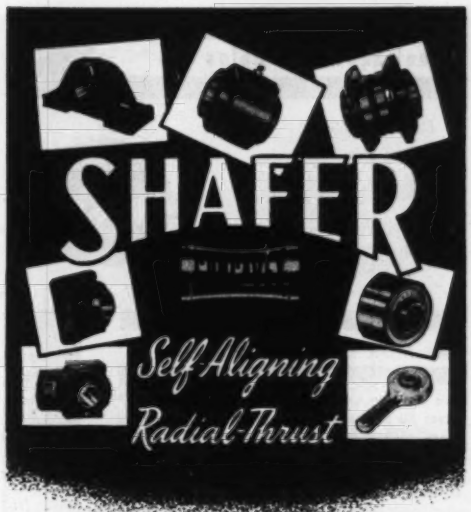

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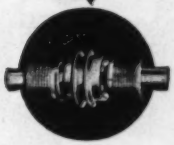

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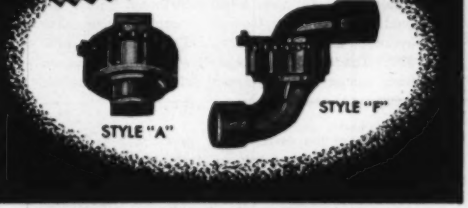

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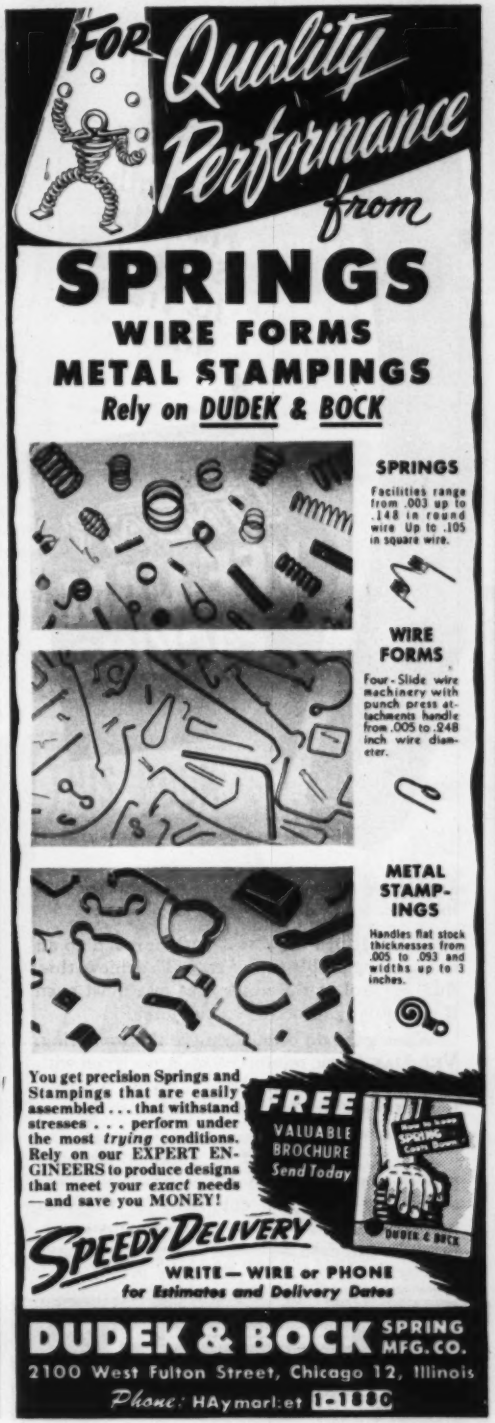
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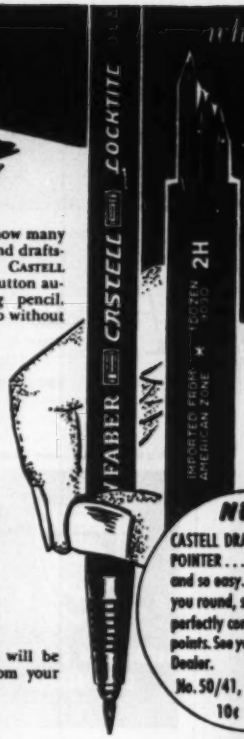

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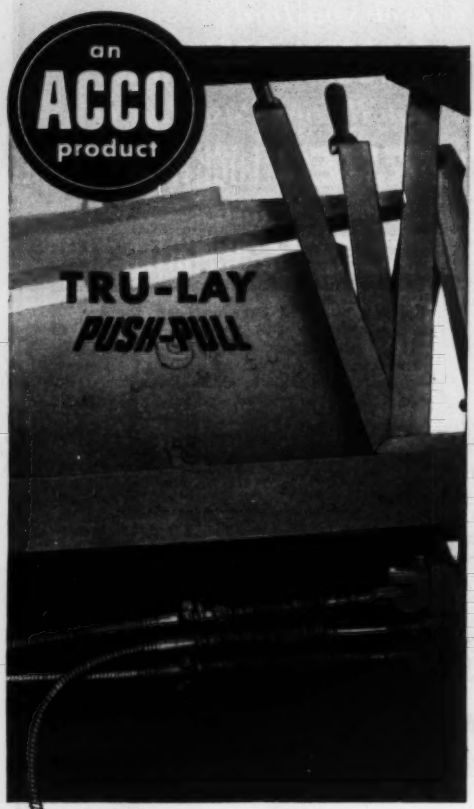

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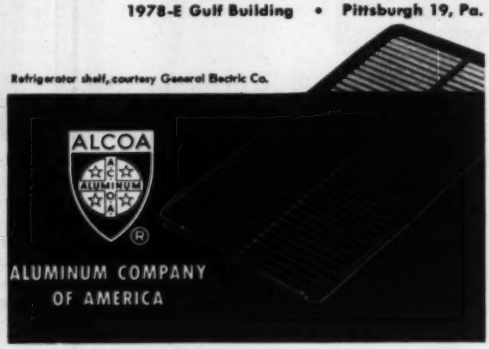

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MECHANICAL ENGINEERING
April, 1952 CARD INDEX Vol. 74, No. 4

Changing Philosophies On Wage Incentives, H. B. Maynard	277
Design Factors for Industrial Heat-Pump Installations, R. J. Martin	280
Progress in Railway Mechanical Engineering, 1950-1951	285
Development of Process Steam Turbines for Industry, A. D. Somes	299
Plastics Literature References, G. B. Thayer	309
Defense Without Inflation — Or Inflation Without Defense?, Romney Robinson	312
Editorial	275
Briefing the Record	315
ASME Technical Digest	330
Contents of ASME Transactions	335
Comments on Papers	336
Books Received in Library	337
ASME News	339
ASME Junior Forum	348
Engineering Societies Personnel Service	349

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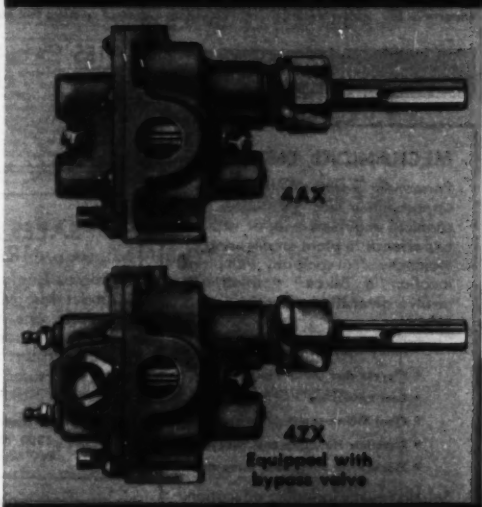
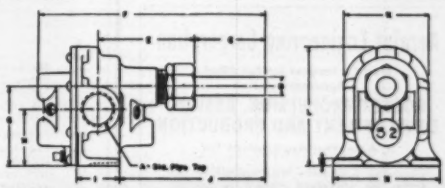


CAPACITY TABLES

Gallons per minute

Pump No.	2 lbs.	20 lbs.	40 lbs.	60 lbs.	80 lbs.	100 lbs.
No. 1½	2.10	1.92	1.75	1.63	1.55	1.50
No. 2	4.10	3.75	3.58	3.42	3.25	3.17
No. 3	7.42	7.08	6.75	6.50	6.33	6.17
No. 4	10.67	10.17	9.67	9.17	8.83	8.50
No. 7	19.75	19.33	19.00	18.67	18.33	18.08
No. 9	23.33	22.92	22.50	22.08	21.67	21.33



DIMENSION TABLE—SERIES 52 PUMPS

Pump No.	A	B	C Min.	E Max.	F	G	H	I	J	K	L	M	N	O
1½	½	⅝	2 1/16	2 21/32	6 1/8	1 1/16	1 13/32	1 1/16	4 1/16	1 13/16	2 27/32	9/16	2 1/4	1 9/16
2	½	½	1 7/16	2 21/32	6 9/16	2 23/64	1 29/32	1 9/32	4 1/32	2 3/8	3 9/16	1/8	2 1/4	1 1/16
3	⅝	⅝	2 1/4	3 1/32	7 1/16	2 5/8	1 7/8	1 9/32	4 17/32	2 3/8	4	1/8	2 1/8	1 3/8
4	½	⅝	2 1/4	3 1/4	7 7/16	2 5/8	1 7/8	1 13/32	4 25/32	2 3/8	4	1/8	2 1/8	1 3/8
7	⅝	⅝	2 1/4	3 9/16	7 7/16	2 9/16	2 9/16	1 13/32	4 25/32	2 3/8	5 1/4	5/16	4	1 9/16
9	1	⅝	2 1/4	3 9/16	7 11/16	2 9/16	2 9/16	1 21/32	4 25/32	2 3/8	5 1/4	5/16	4	1 9/16

PRICE LIST

Pump No.	No. 1½	No. 2	No. 3	No. 4	No. 7	No. 9
Pipe Size	⅛"	¼"	⅜"	½"	¾"	1"
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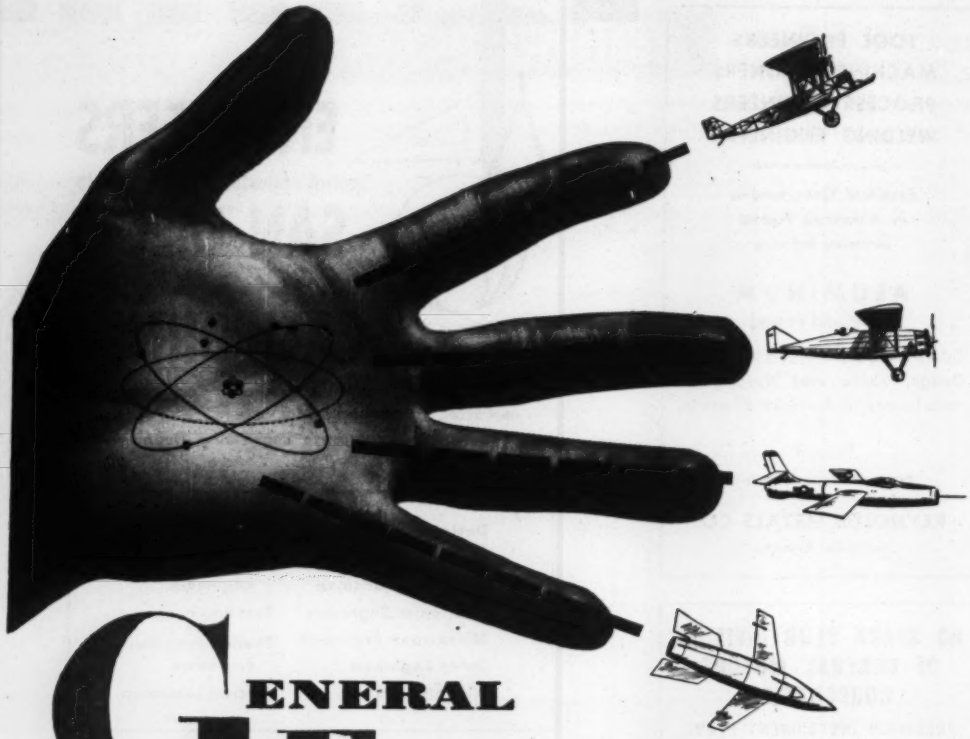

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Creative development engineering executive to head group of 20 engineers engaged in development of extensive line of automatic machinery. Thorough knowledge of project planning, scheduling, and administration essential. Background of mechanical engineering preferred. Age 40–50. Permanent position with a long established midwestern company, a leader in their field. Send complete resumé of education and experience. Salary $12,000 per year.

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Wanted by rapidly growing Electric and Gas Company on East Coast.

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The step up to Aircraft Engineering isn't as steep as you might expect.

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Applied research in fluid flow, heat transfer, thermodynamics, mechanical design generally related to refrigeration and air conditioning. Experimental and design assignments. M.E. or M.S. or 3 years' research experience. Age 26–35. Ability to organize own work and prepare lucid reports on progress.

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Design in refrigeration and associated equipment, particularly hermetics. Mechanical designer with proved record. Minimum ten years' experience in compression equipment design. Sound technical education. Know thermodynamics, heat transfer, kinematics. Open compressor experience would be of interest.

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Address replies, stating qualifications, complete personal data, resumé of experience and salary expected. All replies strictly confidential. Address CA-3892, care of "Mechanical Engineering."

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IN

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Wanted at Once: DESIGN ENGINEER A. Excellent opportunities for advancement in gas turbine work. Must be capable of working from specifications in making layouts of design of complete parts or components including sheet metal construction, taking into consideration manufacturing costs, weight, stress, heat, material properties, mechanics, dynamics, and production problems.

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Write in confidence.

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ALSO NEEDED

Eight Pages of "OPPORTUNITIES" This Month . . . 140-147

POSITIONS OPEN

Continued from Page 146

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Engineer, preferably familiar with methods and equipment used in the production of power and distribution transformers to establish and supervise a manufacturing engineering department.

***Write to*— Engineering Dept. Moloney Electric Co., St. Louis 20, Mo.**

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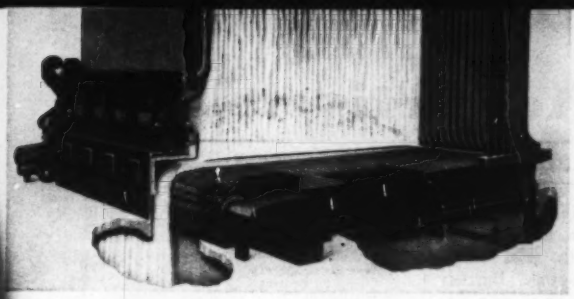

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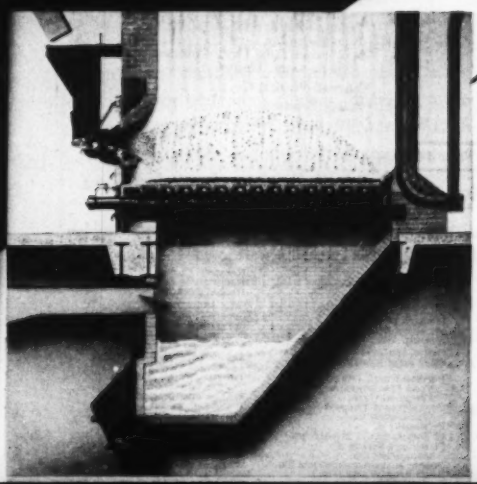

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Index To Advertisers

*Air Preheater Corp. 3
Aluminum Co. of America 138
*American Blower Corp. 10
American Brass Co. 151
*American Flexible Coupling Co. 48
*American Manganese Bronze Co. 137
*American Pulverizer Co. 60
ASME Publications 62, 132
Mechanical Catalog 100
Amplex Mfg. Co., Div. of Chrysler Corp. 6
*Armstrong Machine Works 3rd Cover
Automotive & Aircraft Div., American Chain & Cable Co. 138
*Babcock & Wilcox Co. 2nd Cover
*Barco Mfg. Co. 49
*Bigelow Co. 59
Bigelow-Liptak Corp. 2
*Bin-Dicator Co. 71
*Blaw-Knox Div., Blaw-Knox Co. 71
Bruning, Charles, Co. 7
Brush Development Co. 11
*Buffalo Forge Co. 127
Bundy Tubing Co. 24
Bush Mfg. Co. 120
Carrier Corp. 28
Centriline Corp. 66
Chace, W. M., Co. 44
Chain Belt Co. 84, 85
Clarage Fan Co. 152
Clark Equipment Co., Industrial Truck Div. 45
Cleveland Worm & Gear Co. 29
Climax Molybdenum Co. 56
*Cochrane Corp. 88
Columbia-Geneva Steel Div. 74, 75
*Combustion Engineering-Superheater (Inc.) 21
Cone-Drive Gear Div., Michigan Tool Co. 20
*Crane Packing Co. 68
Cuno Engineering Corp. 80
*DeLaval Steam Turbine Co. 8, 9
*Denison Engineering Co. 16, 70
*Detroit Stoker Co. 149
Diamond Power Specialty Co. 131
Diefendorf Gear Corp. 137
Dow Corning Corp. 42
*Downingtown Iron Works 46
*Dravo Corp., Heating Dept. 78, 79
Dresser Industries (Inc.) Pacific Pumps 43
*Roots-Connersville Blower Corp. 37
Dudek & Bock Spring Mfg. Co. 135
Earle Gear & Machine Co. 135
Eastman Kodak Co. 97, 107
Edward Valves (Inc.) Sub. of Rockwell Mfg. Co. 72, 73
*Elastic Stop Nut Corp. of America 99
Elliott Mfg. Co. 134
Faber-Castell, A. W., Pencil Co. 137
Fairbanks, Morse & Co. 14, 113
Fenwal (Inc.) 12
Flexo Supply Co. 135

*** The asterisk indicates that firm also has product catalog in the 1952 ASME Mechanical Catalog and Directory**

The Only Reference Annual Covering the Mechanical Engineering Field with a Unique Combination of Complete Equipment Directory and Manufacturers' Catalogs. Up-to-date 20-page Insert Catalog of ASME Publications is included. *Published Annually*

*Foote Bros. Gear & Machine Corp. 15
*Foxboro Co. 58, 94, 95
*Gear Specialties (Inc.) 5
*General Electric Co. 26, 27, 81
*Gifford-Wood Co. 126
Golden-Anderson Valve Specialty Co. 47
Graphite Metallizing Corp. 63
*Grinnell Co. 31
Hamilton Mfg. Co. 129
Harper, H. M., Co. 39
Hathaway Instrument Co. 63
Helicoid Gage Div., American Chain & Cable Co. 50
Howell Electric Motors Co. 110
Illinois Gear & Machine Co. 123
Imperial Tracing Cloth 139
Insul-Mastic Corp. of America 121
International Nickel Co. 34
Irving Subway Grating Co. 66
*James, D. O., Gear Mfg. Co. 119
Jenkins Bros. 40
*Johnson, Carlyle, Machine Co. 114
*Keckley, O. C., Co. 64
Kennedy Valve Mfg. Co. 69
Keuffel & Esser Co. 124, 125
*Koppers Co. (Inc.) Fast's Coupling Dept. 102
*Ladish Co. 103
Ledeen Mfg. Co. 58
Lenape Hydraulic Pressing & Forging Co. 134
Lincoln Electric Co. 130
Linear (Inc.) 136
*Link-Belt Co. 87
Lord Mfg. Co. 57
Marsh Instrument Co., Affil. James P. Marsh Corp. 104
*Mercoid Corp. 70
Midwest Piping & Supply Co. 25
Morse Chain Co. 116
*National Airoil Burner Co. 70
New-Departure Div., General Motors Corp. 1
New Hampshire Ball Bearing (Inc.) 139
Nice Ball Bearing Co. 106
Nordstrom Valve Div. of Rockwell Mfg. Co. 90, 91
Oberdorfer Foundries (Inc.) 139
Ohio Injector Co. 101
*Oilgear Co. 117
Pacific Pumps (Inc.) 43
*Pangborn Corp. 67
*Peabody Engineering Corp. 54
Philadelphia Gear Works 83
Powers Regulator Co. 22, 23
*R-S Products Corp. 128
*Read Standard Corp. 52
Reeves Pulley Co. 51
Repro-Templeta (Inc.) 4
Revere Copper & Brass (Inc.) 76
Ric-Wil Co. 60
Rockford Clutch Div. of Borg-Warner Corp. 134
*Roots-Connersville Blower Corp. 37
Ross Heater & Mfg. Co. 92
*Sarco Co. 32
Servel (Inc.) 98
Shafer Bearing Co. 133
Sier-Bath Gear & Pump Co. 61
Smooth-On Mfg. Co. 133
Sponge Rubber Products Co. 96
Streeter-Amet Co. 136
Stuart, D. A., Oil Co. 65
Tennessee Coal & Iron Div. 74, 75
*Terry Steam Turbine Co. 93
Thomas Flexible Coupling Co. 64
Thomson Industries (Inc.) 65
*Timken Roller Bearing Co. 4th Cover
*Tube Turns (Inc.) 17, 18
United States Steel Co. 74, 75
United States Steel Export Co. 74, 75
United States Steel Supply Div. 74, 75
Vickers (Inc.) 105
*Vogt, Henry, Machine Co. 82
Waldes Kohinoor (Inc.) 111
Walworth Co. 118
Waterman Engineering Co. 133
*Westinghouse Air Brake Co. 112
*Westinghouse Electric Corp. 13, 33, 108, 109
*Wheeler, C. H., Mfg. Co. 86
*Wickes Boiler Co., Div. of Wickes Corp. 77
Wiley, John & Sons 53
Winsmith (Inc.) 55
Wolverine Tube Div., Calumet & Hecla Cons. Copper Co. 115
*Yarnall-Waring Co. 35
*Zallea Brothers 30
*Zurn, J. A., Mfg. Co. 19

CONSULTING SERVICE . . . Page 148

Black & Veatch
Ehrco Die Casting Service
Electrical Testing Laboratories
Hathaway, C. M.
Jackson & Moreland
Kendall, George H.
Kuljian Corp.
Mast Development Co.
Myers & Addington
National Weld Testing Bureau
Nuclear Development Assoc.
Palmer, Delos M. & Assoc.
Polachek, Z. H.
Processes Research, Inc.
Sanderson & Porter
Sargent & Lundy
Sirrine, J. E., Co.
Stanley Engineering Co.
Tour, Sam & Co.

Advertisers in Previous 1952 issues but not in this issue

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*Aetna Ball & Roller Bearing Co.
*Aldrich Pump Co.
All American Tool & Mfg. Co.
Allegheny Ludlum Steel Corp.
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American Pencil Co.
Anderson, V. D., Co.
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Aurora Pump Co.
*Bailey Meter Co.
Bell Telephone Laboratories
Birmingham Committee of 100
Bridgeport-Thermostat Div., Robertshaw-Fulton Controls Co.
Briggs & Stratton Corp.
Brown & Sharpe Mfg. Co.
Brownell Co.
Burgess-Manning Co.
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*Engineer Co.
*Erie City Iron Works
Fafnir Bearing Co.
*Farrel-Birmingham Co.
Farval Corp.
Flexonics Corp.
*Foster Wheeler Corp.
Fulton-Sylphon Div., Robertshaw-Fulton Control Co.
*Garlock Packing Co.
General Radio Co.
*Goulds Pumps (Inc.)
Guardian Electric Mfg. Co.
Hagan Corp.
Hankison Corp.
Hannifin Mfg. Co.
*Homestead Valve Mfg. Co.
Hyatt Bearings Div., General Motors Corp.
*Hydropress (Inc.)
Iron Fireman Mfg. Co.
*Johns-Manville Johnson Reprint Corp.
Kellogg, M. W., Co.
*Kewanee Boiler Corp.
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Lefax
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*Pennsylvania Pump & Compressor Co.
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Philbrick, G. A., Researches
Pittsburgh Piping & Equipment Co.
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TDA Brake Div.
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Trane Co.
U.S. Electrical Motors (Inc.)
*Voss, J. H. H., Co.
Water Cooling Equipment Co.
Wiegand, Edwin L., Co.
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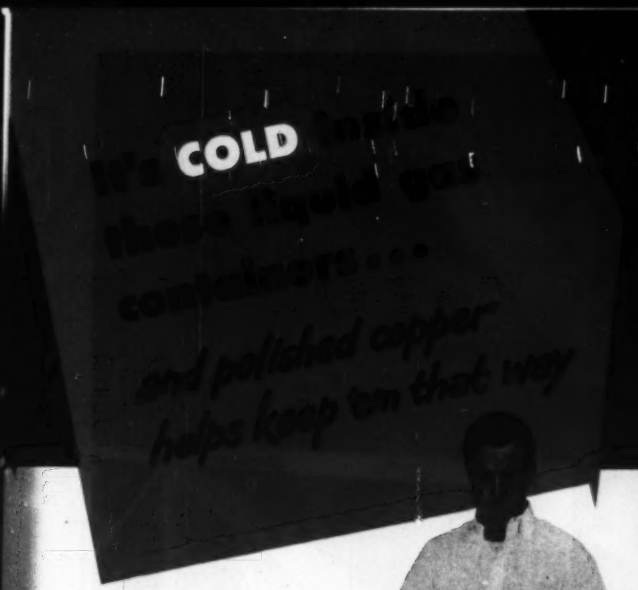
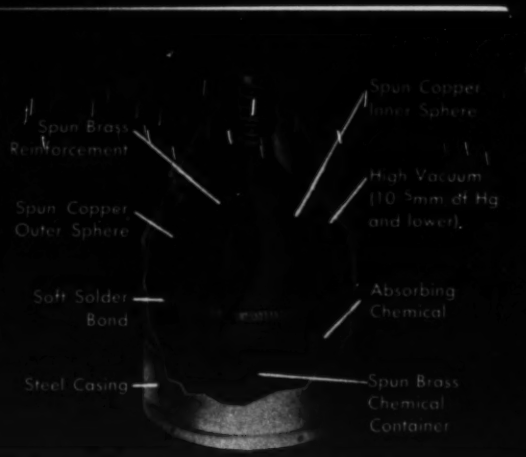
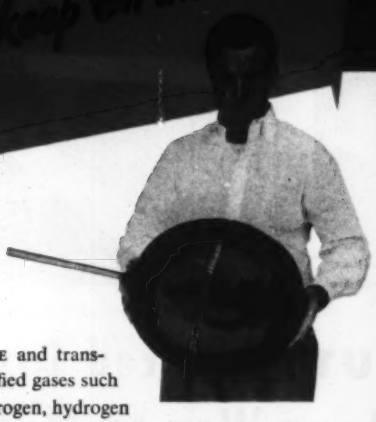




Cutaway section of a Hofman "Standard" Liquefied Gas Container, made in a range of sizes from 5 to 2000-liter capacity.



This is Herb Basewit, design draftsman of Hofman Laboratories, Inc., holding an unretouched polished copper inner shell for a 25-liter container. A perforated spun-brass dish soldered on one end holds a chemical which absorbs any leakage of gas into the vacuum.

Here Herb is seen pointing to the hole for exhausting air to obtain vacuum. A solder bond is used to join the copper hemispheres.

IN THE STORAGE and transportation of liquefied gases such as air, oxygen, nitrogen, hydrogen and helium, evaporation losses are the big problem (containers can't be sealed because of explosion risks). If insulation is not adequate for the *minus*-452 F temperatures encountered, losses are costly.

Hofman Laboratories, Inc., of Newark, N. J. took a big forward step and made some radical changes in container design. Resembling a giant picnic vacuum bottle, the "Standard" Hofman Container is constructed of an inner and outer copper sphere separated by an extremely high vacuum. Bulky insulation is eliminated and, through the use of polished copper, surface radiation losses are greatly reduced.

Here, as in many other industrial applications, copper does a multi-purpose job better than any other metal by providing: (1) the ductility and malleability necessary for deep-spinning the hemispheres, (2) an unequalled metal for soldering, and (3) a smooth-surface, fine-grain metal that will readily take a mirror-like finish.

Anaconda Metals are made by The American Brass Company, General Offices: Waterbury 20, Conn. 5205

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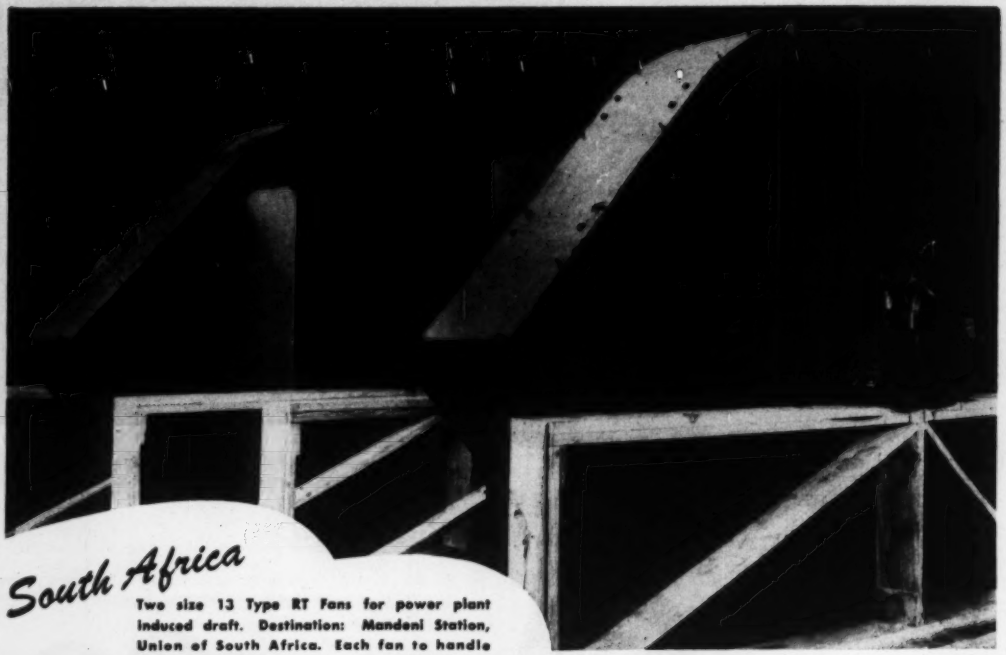

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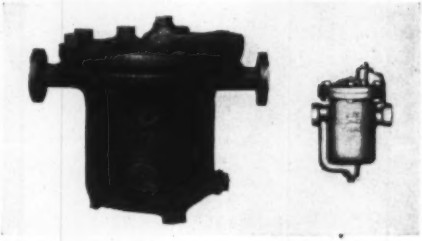

FROM THE RIDICULOUS TO THE SUBLIME . . . **The monstrosity on the left is a steam trap once manufactured in Germany. It weighs 116 lbs. but has no more capacity than the 10½ lb. Armstrong trap on the right. All of which is a means of focussing your attention on the importance of a steam trap leverage system. The size of the big trap is necessary due to its crude-by-comparison leverage design.**

ARMSTRONG steam trap capacity is a bargain size for size because of the patented leverage system. In an Armstrong trap for 100 psig, leverage is higher than in one for, say, 15 psig. Thus, a larger valve can be opened than would be possible if the leverage was the same for all pressures.

That sounds simple, but isn't. If higher leverage is secured with a longer lever arm, a bigger trap body is needed. That's the trouble with the elephant shown at the left. Also the design must permit the valve to open *wide* or it will restrict the orifice, reducing capacity. *Armstrong's design answers these problems better than any other design.*

P. S. When comparing traps be sure capacities are based (as are Armstrongs) on *actual* tests with condensate at steam temperature. No other basis is reliable. ARMSTRONG MACHINE WORKS, 894 Maple St., Three Rivers, Michigan.

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ARMSTRONG STEAM TRAPS

TIMKEN® bearings keep high speed boring mill accurate and free from vibration

THIS 52" King boring mill is especially designed for boring diesel locomotive wheels and facing the rims and hubs. Because carbide tooling is required, the table must rotate at high speeds. To insure smooth boring and facing, the King Machine Tool Division of American Steel Foundries mounts the table spindle on Timken* precision tapered roller bearings. They keep the table accurate, eliminate vibration.

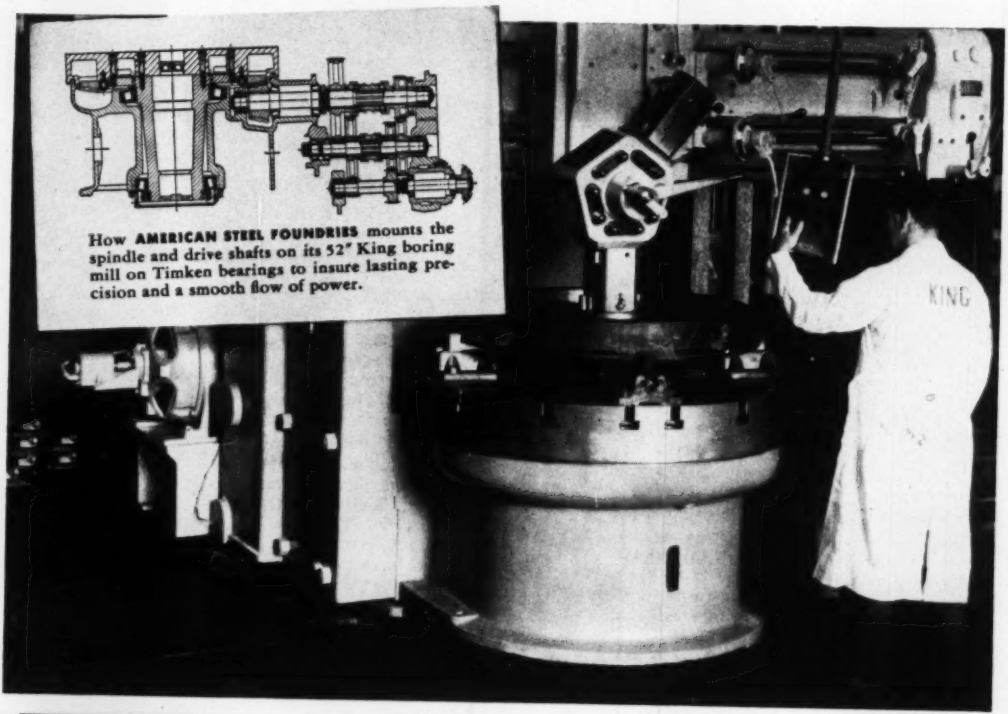
Timken precision bearings are specifically designed for spindle applications. They have capacity for any tool loads because line contact between rollers and races provides load-carrying capacity to spare.

Because of tapered construction, Timken bearings take both radial and thrust loads. Spindles are held in rigid alignment and can be pre-loaded to any desired degree.

The King Machine Tool Division uses Timken bearings on the main drive shaft and in the constant speed and variable speed drives to hold shafts in accurate alignment and insure proper gear meshing.

No other bearing can give you all the advantages you get with Timken bearings. Make sure you have them in the machine tools you buy or build. Look for the trade-mark "Timken" on every bearing. The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

This symbol on a product means its bearings are the best.



How **AMERICAN STEEL FOUNDRIES** mounts the spindle and drive shafts on its 52" King boring mill on Timken bearings to insure lasting precision and a smooth flow of power.

WE MAKE OUR OWN STEEL

The special grade alloy steel which gives Timken bearings their strength and resistance to wear is made in our own steel mills.

The Timken Roller Bearing Company is the acknowledged leader in: 1. advanced design; 2. precision manufacturing; 3. rigid quality control; 4. special analysis steels.

TIMKEN

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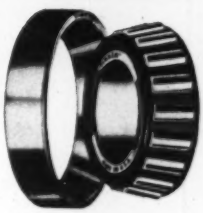
TAPERED ROLLER BEARINGS



NOT JUST A BALL ○ NOT JUST A ROLLER ⊂⊃ THE TIMKEN TAPERED ROLLER ⊂⊃ BEARING TAKES RADIAL ◫ AND THRUST →◫← LOADS OR ANY COMBINATION ✳